



The Center for Aerosol Science & Engineering (CASE) at Washington University in St. Louis is focused on the **advancement of science and technology of aerosol systems**. CASE works to characterize fundamental aerosol formation and transformation processes to determine impacts on the environment, climate, and human health; and to utilize these processes to develop new materials to enable energy, environmental & medical technologies. The center is composed of a collaborative group of faculty, students, and affiliates within the department of EECE and across the university, as well as partners in universities and corporations across the globe. CASE activities include extensive collaborative research with shared instrumentation facilities, education through coordinated coursework and workshops, seminars and discussion groups, and social networking events.

Core faculty



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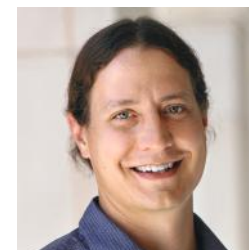
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Air Quality Management, Air
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Quality Management; CAPITA Lab

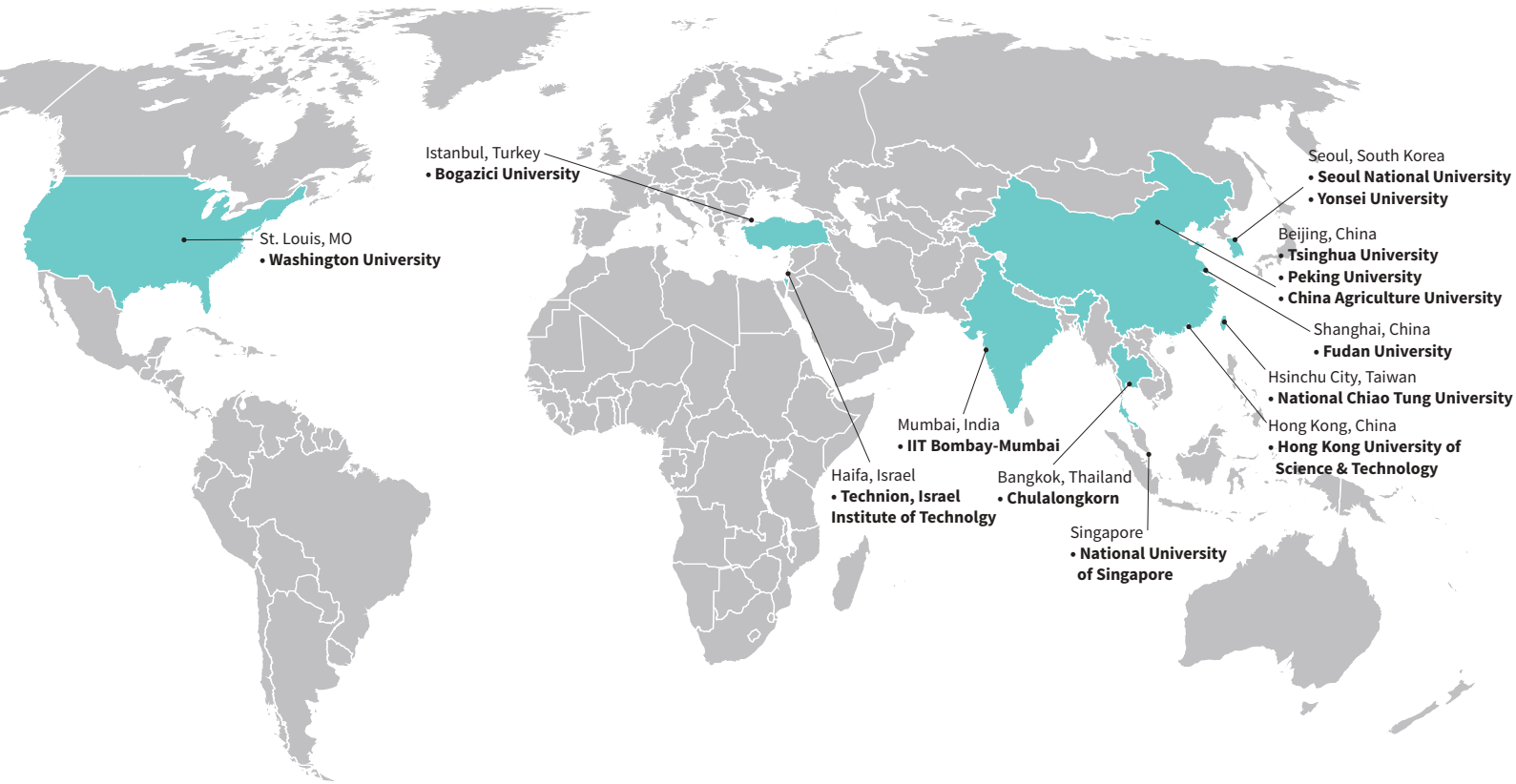
AFFILIATED FACULTY

Su Huang (EECE)
Benjamin Kumfer (EECE)
Tianxiang Li (EECE)
Grigoriy Yablonsky (EECE)

RESEARCH FACULTY

Samuel Achilefu
(School of Medicine)
Raymond Arvidson
(Earth & Planetary
Sciences)
Hilary Babcock
(School of Medicine)
John Fortner (EECE)
Young-Shin Jun (EECE)
Vijay Ramani (EECE)
Srikanth Singamaneni
(Mechanical Engineering
& Materials Science)
Lan Yang
(Electrical & Systems
Engineering)

CASE partner universities



MAGEEP AEROSOL NETWORK

- » National University of Singapore — B. Rajasekhar, J. Yu
- » Chulalongkorn University — A. Suriyawong
- » Seoul National University — M. Choi
- » Yonsei University — T.G. Lee, J. Jeong
- » Tsinghua University — J. Hao, J. Jiang, Y. Wu, S. Wang, S. Li, Q. Yao
- » Peking University — M. Hu
- » China Agricultural University — R. Dong, Y. Zhou
- » Fudan University — Y. Zhang, J. Chen
- » Hong Kong University of Science and Technology — I. Lo
- » IIT Bombay — C. Venkataman, V. Sethi
- » Technion — G. Grader, M. Shapiro
- » Bogazici — O. Yenigun
- » National Chiao Tung University — H. Bai, C.J. Tsai

HIGHLIGHTS

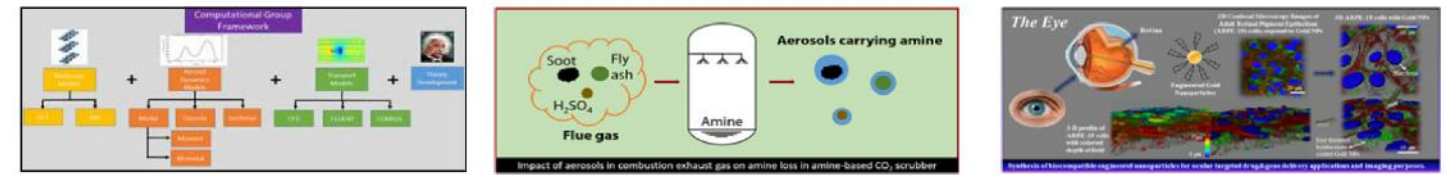
- » Editor-in-Chief, *J Aerosol Science* (Pratim Biswas)
- » USEPA Science Advisory Board Member (Jay R. Turner)
- » Past Presidents of AAAR (Pratim Biswas, 2006-07 and Jay R. Turner 2013-14)
- » International Aerosol Research Assembly Vice President, President Elect (Pratim Biswas)
- » Working Group and Tutorial Chairs of AAAR (Rajan Chakrabarty, Brent Williams and Pratim Biswas)
- » Host of 10th International Aerosol Conference, St. Louis, September 2-7, 2018
- » Alumni as leading faculty members and corporate leaders

SELECTED METRICS (2016)

- » Total Research Expenditures in 2016 = \$ 4M
- » Refereed Journal Publications in 2016 = 55
- » Current PhD Students Advised = 35
- » Average H-Index = 22
- » Funding Agencies: NSF, USEPA, USDOE, NASA, NIH and industry

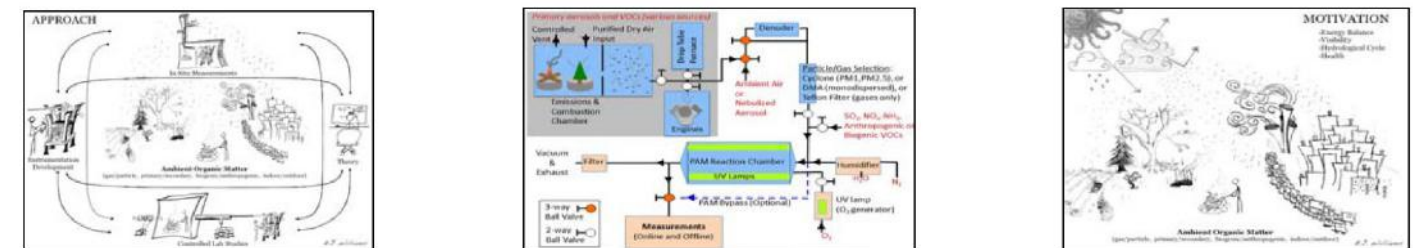
State-of-the-art aerosol research laboratories

Aerosol and Air Quality Research Lab (AAQRL) (aerosols.eece.wustl.edu)



The Aerosol and Air Quality Research Laboratory (AAQRL) focus is on research and education related to particulates in gaseous suspension, known as aerosols. AAQRL's contributions to this field span the full process of technology development, from synthesis and characterization to eventual application. Through this research, we aim to mitigate the negative impacts of aerosols on the environment and leverage their potential as nanoparticles for application in energy, environment, medicine and agriculture.

Atmospheric Chemistry and Technology Lab (ACT) (actlab.seas.wustl.edu)



Through novel laboratory and field measurements, ACT works to determine the sources, composition, transformation, and fate of atmospheric biogenic and anthropogenic organic gases and particles, which are detrimental to human health, affect the hydrological cycle, and affect the Earth's energy balance.

Aerosol Impacts & Research Lab (AIR) (air.eece.wustl.edu)



Investigating the role of atmospheric aerosols in earth's energy balance using novel instrumentation and diagnostic techniques, and numerical models; and understanding aerosol formation in combustion systems toward synthesis of high porosity and surface-area materials for energy applications.

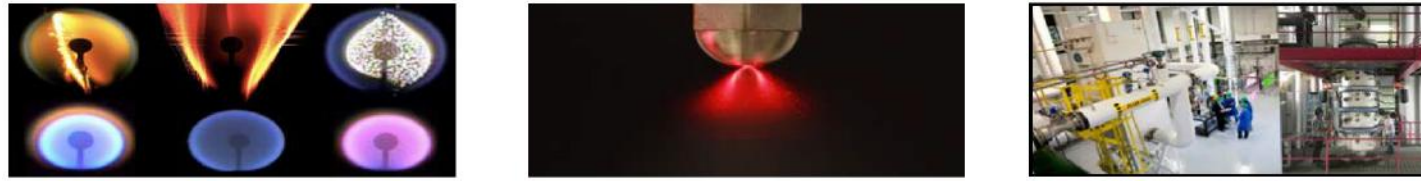
Interface Research Group (sites.wustl.edu/irg1)



Interface Research Group studies systems in which interfaces play a central role. Specifically, focus is on thin films and nanostructured materials.

State-of-the-art aerosol research laboratories

Laboratory for Advanced Combustion & Energy Research (LACER) (wulacer.com)



LACER develops approaches to synthesize advanced materials for electrical vehicles, conducts fundamental studies of combustion, studies combustion of renewable fuels, and develops novel approaches to reduce emissions from power plants. LACER has advanced large scale facilities for combustion research.

The Jay Turner Lab (users.seas.wustl.edu/jrtturner)



The Jay Turner Lab focuses on air quality characterization with emphasis on field measurements and data analysis to support a variety of applications in the atmospheric science, regulation and policy, and health studies arenas. One thrust, with projects in both the United States and abroad, is research to inform air quality planning and management.

Affiliated centers



McDonnell Academy
Global Energy and Environment
Partnership (MAGEEP)
mageep.wustl.edu



Consortium for
Clean Coal
Utilization (CCCU)
cccu.wustl.edu



Solar Energy and
Energy Storage
(SEES)
solarstorage.wustl.edu



International Center
for Energy and Sustainability
(InCEES)
incees.wustl.edu

National & International Organizations



European Aerosol Assembly (EAA)



CASE Student Chapter



The CASE Student Chapter works to support our parent center and coordinate its student focused activities. Our membership includes over 35 graduate students in energy, environment, materials, health and other areas of applied research. Our foremost goal is to help advance the research, educational and professional goals for aerosol science students at WashU. To that end, we organize technical workshops and lectures to help students develop skills in practical or advanced topics not necessarily taught in a classroom. We also hold monthly happy hours where faculty members discuss topics ranging from their professional journeys to the history of aerosol science to recent events related to aerosols and related fields. Occasionally, WashU hosts seminars or workshops by leading aerosol scientists from across the world; the CASE student chapter facilitates informal meetings between the visitors and students interested in their research. Another goal of our organization is to increase the capabilities and presence of aerosol research at WashU, in affiliation with other graduate student bodies on WashU as well as with nationally recognized organizations in the field of aerosol science. We serve as the WashU chapter for the American Association of Aerosol Research (AAAR), and are working to use AAAR conferences as a platform for encouraging more connectivity with our alumni.

CURRENT PHD STUDENTS

Ahmed Abokifa	Bedia Karakocak	Nathan Reed
Adewale Adeosun	Shalinee Kavadiya	Girish Sharma
Jiung-Wen Chen	Dishant Khatri	Kuan-Yu Shen
Audrey Dang	Jiayu Li	Nishit Jaideep Shetty
Sukrant Dhawan	Zhichao Li	Benjamin Sumlin
Claire Fortenberry	Pai Liu	Yuanzi Sun
Akshay Gopan	Jose Madero Munoz	Che Tan
Kelsey Haddad	Yao Nie	Necip Uner
Phillip Johnson	Christopher Oxford	Piyush Kumar Verma
Sungyoon Jung	Apoorva Pandey	Michael Walker
Clayton Kacica	Pradeep Sivaprabha Prathibha	Yang Wang

POST DOCTORAL STUDENTS

William Heinson
Yuli Heinson
David Stokie
Zhiwei Yang

RESEARCH AND VISITING SCIENTISTS

Ray Ehrhard
Yanjie Hu
Ramesh Raliya
Xuebin Wang
Liang-Yi Yin

2016 publications

- Xia, F., Yang, Z., Adeosun, A., Gopan, A., **Kumfer**, B. M., & **Axelbaum**, R.L. "Pressurized oxy-combustion with low flue gas recycle: Computational fluid dynamic simulations of radiant boilers." *Fuel*, 181, 1170-1178, 2016.
- Wu, W., **Yablonsky**, G. & **Axelbaum**, R. L., "Observation of water-gas shift equilibrium in diffusion flames." *Combustion and Flame*, 173, 57-64, 2016.
- Wang, X., Jing, H., Dhungel, B., Wang, W. N., **Kumfer**, B. M., **Axelbaum**, R. L. and **Biswas**, P. "Characterization of organic and black carbon aerosol formation during coal combustion: An experimental study in a 1MW pilot scale coal combustor." *Fuel*, 180, 653-658, 2016.
- Greenberg, J.B., Mindelis, Y. and **Axelbaum**, R.L., "A simple model of a water/fuel spray diffusion flame." *Fuel*, 181, 547–556, 2016
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- Raliya, R., Franke, C., Chavalmane, S., Nair, R., Reed, N., and **Biswas**, P., "Quantitative understanding of nanoparticle uptake in watermelon plants." *Frontiers in Plant Science*, 7, 1288, doi: 10.3389/fpls.2016.01288, 2016.
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- Jiang, Y., Raliya, R., **Fortner**, J. and **Biswas**, P., "Graphene oxides in water: Correlating morphology and surface chemistry with aggregation behavior." *Environmental Science & Technology*, 50, 6964-6973, 2016. Jiang, Y., Liu, D., Cho, M., Lee, S.S., **Zhang**, F., **Biswas**, P., and **Fortner**, J., "In situ photocatalytic synthesis of ag nanoparticles (nAg) by crumpled graphene oxide composite membranes for filtration and disinfection applications." *Environmental Science & Technology*, 50, 2514 2521, 2016.
- Jiang, Y., **Biswas**, P., and **Fortner**, J., "A review of recent developments in graphene-enabled membranes for water treatment." *Environmental Science: Water Research & Technology*, 2, 915-922, 2016.
- Jiang, Q., Tian, L., Liu, K.K., Tadepalli, S., Raliya, R, **Biswas**, P., Naik, R.R. and Singamaneni, S., "Bilayered biofoam for highly efficient solar steam generation." *Advanced Materials*, 28, 9400-9407, 2016.
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- Abokifa, A. A., Yang, Y.J., Lo, C.S. and **Biswas**, P., "Investigating the role of biofilms in trihalomethane formation in water distribution systems with a multicomponent model." *Water Research*, 104, 208-219, 2016.
- de Carvalho, B.A., Kavadiya, S., **Huang**, S., Niedzwiedzki, D.M. and **Biswas**, P., "Highly Stable Perovskite Solar Cells Fabricated Under Humid Ambient Conditions" *IEEE Journal of Photovoltaics*, vol.PP, no.99, pp.1-7, 2016
- Huang, X., Huang, S., **Biswas**, P. and Mishra, R., "Band Gap Insensitivity to Large Chemical Pressures in Ternary Bismuth Iodides for Photovoltaic Applications" *Journal of Physical Chemistry C*, 120 (51), pp 28924–28932, 2016

2016 publications *continued*

- Abokifa, A.A., Yang, Y.J., Lo, C.S. and **Biswas**, P., "Water quality modeling in the dead end sections of drinking water distribution networks" *Water Res.*, 89, 107–117, 2016
- Ellis, A., Edwards, R., Saunders, M., **Chakrabarty**, R.K., Subramanian, R., Timms, N.E., Riessen, A., Smith, A.M., Lambrinidis, D., Nunes, L. J., Vallelonga, P., Goodwin, I.D., Moy, A.D., Curran, M.A. and Ommen, T.D. "Individual particle morphology, coatings, and impurities of black carbon aerosols in Antarctic ice and tropical rainfall." *Geophys. Res. Lett.* 43, 22, 2016
- Bisht, D. S., Tiwari, S., Dumka, U.C., Srivastava, A.K., Safai, P.D., Ghude, S.D., Chate, D.M., Rao, P.S.P, Ali, K., Prabhakaran, T., Panickar, A.S., Soni, V.K., Attri, S.D., Tunved, P., **Chakrabarty**, R.K., Hopke, P.K., "Tethered balloon-born and ground-based measurements of black carbon and particulate profiles within the lower troposphere during the foggy period in Delhi, India." *Sci. Tot. Env.* 573, 894-905, 2016
- Pandey*, A., Pervez, S. and **Chakrabarty**, R. K., "Filter-based measurements of UV–vis mass absorption cross sections of organic carbon aerosol from residential biomass combustion: Preliminary findings and sources of uncertainty." *J. Quant. Spectrosc. Radiat. Transfer*, 182, 296-304, 2016
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- Tiwari, S., Dumka, U.C, Hopke, P.K., Tunved, P., Srivastava, A.K., Bisht, D.S., and **Chakrabarty**, R.K. "Atmospheric heating due to black carbon aerosol during the summer monsoon period over Ballia: A rural environment over Indo-Gangetic Plain." *Atmos. Res.*, 178, 393-400, 2016
- Pandey*, A., and **Chakrabarty**, R.K., "Scattering directionality parameters of fractal black carbon aerosols and comparison with the enyey–Greenstein approximation." *Opt. Lett.* 41 (14), 3351-3354, 2016
- Dewangan, S., Pervez, S., **Chakrabarty**, R.K., Watson, J. G, Chow, J.C., Pervez, Y., Tiwari, S., and Rai, J., "Study of carbonaceous fractions associated with indoor PM_{2.5}/PM₁₀ during Asian cultural and ritual burning practices." *Building and Environment*, 106, 229-236, 2016
- Chakrabarty**, R. K., Gyawali, M., Yatavelli, R.L.N., *Pandey*, A., Watts, A.C., Knue, J., Chen, L.W.A., Pattison, R.R., Tsibart, A., Samburova, V. and Moosmüller, H. "Brown carbon aerosols from burning of boreal peatlands: microphysical properties, emission factors, and implications for direct radiative forcing." *Atmos. Chem. Phys.*, 16 (5), 3033-3040, 2016
- Heinson, W. R. and **Chakrabarty**, R.K., "Fractal morphology of black carbon aerosol enhances absorption in the thermal infrared Wavelengths." *Opt. Lett.*, 41 (4), 808-811, 2016
- Liu, P. and **Chakrabarty**, R.K., "Sensitivity analysis of aggregate morphology on mass-mobility relationship and improved parameterizations." *Aerosol Sci. Tech.*, 50 (1), 63-70, 2016
- Pervez, S., **Chakrabarty**, R.K., Dewangan, S., Watson, J.G., Chow, J.C. and Matawale, J.L., "Chemical speciation of aerosols and air quality degradation during the festival of lights (Diwali)." *Atmos. Poll. Res.* 7 (1), 92-99, 2016

- Lanigan, D. and **Thimsen**, E., "Contact Radius and the Insulator–Metal Transition in Films Comprised of Touching Semiconductor Nanocrystals" *ACS Nano* 10, 6744-6752, 2016
- Ephraim, J., Lanigan, D., Staller, C., Milliron, D.J. and **Thimsen**, E., "Transparent Conductive Oxide Nanocrystals Coated with Insulators by Atomic Layer Deposition" *Chem. Mater.* 28, 5549-5553, 2016
- Yin, B., Sadtler, B., Berezin, M.Y. and **Thimsen**, E., "Quantum dots protected from oxidative attack using alumina shells synthesized by atomic layer deposition" *Chem. Commun.* 52, 11127-11130, 2016
- Feinberg, S., Heiken, J., Valdez, M., Lyons, J. and **Turner**, J., "Modeling of Lead Concentrations and Hotspots at General Aviation Airports" *Transportation Research Record: Journal of the Transportation Research Board*, 2569, 80 –87, 2016
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- Busby, B., Ward, T., **Turner**, J., and Palmer, C., "Comparison and Evaluation of Methods to Apportion Ambient PM_{2.5} to Residential Wood Heating in Fairbanks, AK" *Aerosol and Air Quality Research*, 16, 492–503, 2016
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- Zhang, Y., **Williams**, B.J., Goldstein, A.H., Docherty, K.S., and Jimenez, J.L., "A technique for rapid source apportionment applied to ambient organic aerosol measurements from the Thermal desorption Aerosol Gas chromatograph (TAG)" *Atmos. Meas. Tech. Discuss.*, 211, 2016
- Martinez, R.E., **Williams**, B.J., Zhang, Y., Hagan, D., Walker, M., Kriesberg, N.M., Hering, S.V., Hohaus, T., Jayne, J.T., Worsnop, D.R., "Development of a Volatility and Polarity Separator (VAPS) for Volatility- and Polarity-Resolved Organic Aerosol Measurement" *Aerosol Science and Technology*, 50:3, 255-271, 2016
- Williams**, B.J., Zhang, Y., Zuo, X., Martinez, R.E., Walker, M.J., Kreisberg, N.M., Goldstein, A.H., Docherty, K., Jimenez, J.L., "Organic and inorganic decomposition products from the thermal desorption of atmospheric particles" *Atmos. Meas. Tech.*, 9, 1569-1586, 2016

CASE alumni



Christopher Hogan, PhD

Benjamin Mayhugh Associate Professor and McKnight Land-Grant Professor, University of Minnesota College of Science & Engineering

Hogan's lab at Minnesota focuses on the fundamentals of the physics and chemistry of very small particles in the gas phase, called aerosol nanoparticles. While application is secondary to his research, potential applications include new particle formation in the atmosphere, combustion emissions or materials synthesis in high temperature reactors.

While a doctoral student at Washington University, Pratim Biswas was Hogan's adviser, but he also worked with Michael Gross, professor of chemistry. He credits both of them with influencing him to go into academic research. Hogan had 22 refereed journal publications from his PhD work at CASE in Washington University in St Louis.



Melissa Holtmeyer, PhD

AAAS Science and Technology Policy Fellow, U.S. Department of Defense

Melissa Holtmeyer has helped shape the direction of national science and technology policy through her opportunities as an American Association for the Advancement of Science (AAAS) Science and Technology policy fellow in both the U.S. Senate and the U.S. Department of Defense, where she is currently performing the duties of the deputy director for Energy Security in the Office of the Secretary of Defense.

Using her engineering background, she advised senators and congressional staffers on energy, environment and climate change legislation. At the DoD, she is helping to develop plans to reduce military fuel use, ensure secure fuel supplies for global operations and provide technical expertise on next-generation DoD technologies to military leaders.

While her background in fundamental combustion has been drawn upon many times, her communication and writing skills, approach to solving problems and ability to understand highly technical topics have been valued assets and respected by high-level leaders. Holtmeyer worked with Professor Axelbaum for her PhD.