

CAREY L. FRIEDMAN

Maine Maritime Academy, [Corning School of Ocean Studies](#)
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ACADEMIC PREPARATION

PhD Oceanography, Graduate School of Oceanography - University of Rhode Island 2010
Dissertation title: Using Passive Samplers to Measure the Bioavailability and Transport of Sedimentary Organic Contaminants. Advisor: Prof. Rainer Lohmann.
MS Environmental Toxicology, Cornell University 2005
BS Chemistry, Trinity College 2002

EXPERIENCE

ASSISTANT PROFESSOR OF MARINE SCIENCE 2015-present
Maine Maritime Academy, Corning School of Ocean Studies

Teaching:

General Chemistry I and II for Ocean Studies, lecture and lab; Engineering Chemistry lecture and lab, Senior Research, Introduction to Marine Pollution.

Grants:

August 2017-2019

NSF EPSCoR SEANET (co-PI) project in collaboration with U. Maine. **\$20,092** awarded each summer in support of a number of activities to determine the viability of aquaculture in the Bagaduce. Funds supported summer and in-term research for undergraduate students.

August 2017

MMA Sawyer Funds (PI; \$1900) awarded to match support from ME Sea Grant.

July 2017

Maine Sea Grant Program Development funds (PI; \$2260) awarded to support project determining whether microplastics in Penobscot Bay carry flame retardants.

May 2017

NSF Major Research Instrumentation (PI; \$381,585) for the purchase of a GC/MS to conduct in-house chemical analysis on environmental samples at MMA.

May 2016

MMA Sawyer Funds (PI; \$6800) awarded for the purchase of a rotary evaporator in support of in-house environmental sample analysis.

POSTDOCTORAL ASSOCIATE 2010-2015
MIT Center for Global Change Science, Joint Program on the Science and Policy of Global Change, Leading Technology and Policy Initiative, and Center for Environmental Health Sciences
Advisor: Dr. Noelle E. Selin

Developed a 3-D global atmospheric model to investigate the behavior and transport of polycyclic aromatic hydrocarbons (PAHs), toxic by-products of combustion. In collaboration

with colleagues at Harvard and Colorado State, I used the model to assess the effects of projected climate and emissions changes on global PAH cycling, and of different types of atmospheric particulate matter on transport of PAHs to the Arctic.

Led the development of a polychlorinated biphenyl (PCB) atmospheric transport and Earth surface exchange model; collaborated with Harvard and MIT to link the atmospheric model to a global ocean model. Used joint model to assess PCB transport to the Arctic under present and future climate and emissions conditions.

Took a leadership role in two NSF-funded multidisciplinary, multi-institutional projects involving the use of the PAH and PCB models for assessing the global cycling of toxic pollutants on different time scales and associated socioeconomic effects.

GRADUATE FELLOW/RESEARCHER

2008-2010

Graduate School of Oceanography, University of Rhode Island

Evaluated the use of passive samplers to measure the bioavailability of PCDD/Fs and PBDEs (toxic pollutants) in air, water, and sediment in Newark Bay, New Jersey, near the Diamond Alkali U.S. EPA Superfund site. Planned, organized, and conducted all field work for the above project; collaborated with scientists and engineers at Rutgers University, University of Delaware, and the U.S. EPA.

GRADUATE RESEARCHER/STUDENT CONTRACTOR

2006-2008

Atlantic Ecology Division, U.S. Environmental Protection Agency

Evaluated the use of passive samplers as biomimetic tools in sedimentary bioaccumulation tests and investigated the effect of sediment resuspension on PCB bioavailability. Conducted routine sediment and seawater toxicity tests.

INSTRUCTOR

Simmons College

2006

Taught introductory organic chemistry laboratory to ~30 non-majors.

RESEARCHER

Simbiotic Software

2005-2006

Collected data for the distribution of ecology/evolution academic software. Evaluated the effectiveness of software in communicating biological concepts.

GRADUATE FELLOW/RESEARCHER

2003-2005

Environmental Toxicology Program, Cornell University

Measured the degradation kinetics of acetanilide herbicides in wastewater using anodic Fenton treatment.

ENVIRONMENTAL SCIENTIST

2002-2003

Casco Bay Estuary Partnership, University of Southern Maine

Collected sediment and water from the State of Maine for the U.S. EPA's National Coastal Assessment program.

TEACHING

Maine Maritime Academy, Castine, ME (2015-present)

General Chemistry I (CH210) for Marine Bio/Science majors; lecture and lab
General Chemistry II (CH220) for Marine Bio/Science majors; lecture and lab
Engineering Chemistry (CH352) for Marine Systems Engineering majors; lecture and lab
Senior Research (OS401) for Marine Bio/Science majors; lecture and lab

Simmons College, Boston, MA (2006)

Organic Chemistry for non-majors; lab

Trinity College, Hartford, CT (2001)

Analytical Chemistry, Teaching Assistant
General Chemistry, Tutor

ADVISING AND MENTORING

Academic Advising

Maine Maritime Academy

Between 10 and 14 Marine Biology or Marine Biology/Small Vessel Operations majors (Fall 2016 - present)

Research Advising

MMA

Alexa Cacacie (undergraduate SEANET summer intern, 2019)
Abigail L'Abbe (undergraduate SEANET summer intern, 2019)
Huxley Conner (undergraduate SEANET bioregional student, 2018-present)
Susana DeFrank (undergraduate SEANET summer intern, 2018)
Ashlyn Royal (undergraduate SEANET summer intern, 2018)
Connor Daugherty (undergraduate SEANET bioregional student, 2017-2018)
Caroline Foy (undergraduate SEANET bioregional student, 2017-2018)

MIT

Colin Thackray (PhD student, 2012-2014)
Emily Field (high school summer student, 2012)
Anthony Longboat (undergraduate, 2011)
Abigail Koss (undergraduate, 2010)

University of Rhode Island

Bridget Reaney (undergraduate, 2006-2007)
Stephanie Schubert (undergraduate, 2006-2007)

PUBLICATIONS

Journal articles (peer-reviewed):

16. Wagner, CC; Amos, HM; Thackray, CP; Zhang, Y; Lundgren, EW; Forget, G; **Friedman, CL**; Selin, NE; Lohmann, R; Sunderland, EM. 2019. A global 3-D ocean model for PCBs: Benchmark compounds for understanding the impacts of global change on neutral persistent organic pollutants. *Global Biogeochem. Cycles*. 33, <https://doi.org/10.1029/2018GB006018>.

15. Bates, ML; Bigot, M; Cropp, RA; Engwirda, D; **Friedman, CL**; Hawker, DW. 2016. On the formulation of environmental fugacity models and their numerical solutions. *Environ. Toxicol. Chem.* 35: 2182-2191.
14. **Friedman, CL**; Selin, NE. 2016. PCBs in the Arctic atmosphere: determining important driving forces using a global atmospheric transport model. *Atmos. Chem. Phys.* 16: 3433-3448.
13. Thackray, CP; **Friedman, CL**; Zhang Y; Selin, NE. 2015. Quantitative assessment of parametric uncertainty in northern hemisphere PAH concentrations. *Environ. Sci. Technol.*, 19:9185-9193.
12. **Friedman, CL**; Pierce, JR; Selin, NE. 2014. Assessing the influence of secondary organic versus primary carbonaceous aerosols on long-range atmospheric PAH transport. *Environ. Sci. Technol.*, 48:3293-3302.
11. **Friedman, CL**; Zhang, Y; Selin, NE. 2014. Climate change and emissions impacts on atmospheric PAH transport to the Arctic. *Environ. Sci. Technol.*, 48:429-437.
10. **Friedman, CL**; Lohmann, R. 2013. Comparing sediment geochemistry and passive sampler techniques to estimate benthic biota PCDD/F concentrations in Newark Bay, New Jersey (U.S.A.). *Environ. Poll.*, 186:172-179.
9. **Friedman, CL**; Selin, NE. 2012. Long-range atmospheric transport of polycyclic aromatic hydrocarbons: A global 3-D model analysis including evaluation of Arctic sources. *Environ. Sci. Technol.*, 46(17): 9501-9510.
8. **Friedman, CL**; Cantwell, MG; Lohmann, R. 2012. Passive sampling provides evidence for Newark Bay as a source of PCDD/Fs to the New York/New Jersey atmosphere. *Environ. Toxicol. Chem.*, 31(2): 253-361.
7. Lambert, MK; **Friedman, CL**; Luey, P; Lohmann, R. 2011. The role of black carbon in the sorption of polychlorinated dibenzo-p-dioxins and dibenzofurans at the Diamond Alkali Superfund site, Newark Bay, NJ. *Environ. Sci. Technol.* 45(10): 4331-4338.
6. Perron, MM; Burgess, RM; Ho, KT; Pelletier, MC; **Friedman, CL**; Cantwell, MG; Shine, JP. 2011. Limitations of reverse polyethylene samplers (RePES) for evaluating toxicity of field contaminated sediments. *Chemosphere.* 83(3): 247-254.
5. **Friedman, CL**; Lohmann, R. Burgess, RM; Perron, MM; Cantwell, MG. 2011. Resuspension of polychlorinated biphenyl-contaminated field sediment: Release to the water column and determination of site-specific K_{DOC} . *Environ. Toxicol. Chem.* 30(2): 377-384.
4. **Friedman, CL**; Burgess, RM; Cantwell, MG; Ho, KT; Lohmann, R. 2009. Comparing polychaete bioaccumulation and passive sampler uptake to assess the effects of sediment resuspension on PCB bioavailability. *Environ. Sci. Technol.* 43(8): 2865-2870.
3. Perron, MM; Burgess, RM; Ho, KT; Pelletier, MC; **Friedman, CL**; Cantwell, MG; Shine, JP. 2009. Development and evaluation of reverse polyethylene samplers for marine phase II whole-sediment toxicity identification evaluations. *Environ. Toxicol. Chem.* 28(4): 749-758.
2. Burgess, RM; Perron, MM; **Friedman, CL**; Suuberg, EM; Pennell, KG; Cantwell, MG; Pelletier, MC; Ho, KT; Serbst, JR; Ryba, SA. 2009. Evaluation of the effects of coal fly ash amendments on the toxicity of contaminated marine sediments. *Environ. Toxicol. Chem.* 28(1): 26-35.
1. **Friedman, CL**; Lemley, AT; Hay, AG. 2006. Degradation of chloroacetanilide herbicides by anodic Fenton treatment. *J. Agric. Food Chem.* 54(7): 2640-2651.

Other publications:

3. **Friedman, CL**; Selin, NE. 2011. Long-range transport of polycyclic aromatic hydrocarbons: A global 3-D model analysis including evaluation of Arctic sources. Report to the MIT Joint Program on the Science and Policy of Global Change.
2. **Friedman, CL**. 2010. Using passive samplers to measure the bioavailability and transport of PCDD/Fs and PBDEs in Newark Bay. Report to the Hudson River Foundation, Grant No. GF/01/09.
1. Derbyshire, E; **Friedman, C**; Grant, A. 2002. Determination of chromium and arsenic in pressurized wood and surrounding soil. *The Trinity Papers*.

PRESENTATIONS

31. Bartlett, P; Li, Y; Gusev, A; Ma, J; Tao, S.; **Friedman, C**; Guardans, R; Muntean, M; Kelly, J; Selin, N; POPs/EC Long Range Transport & Emission Uncertainties: Opportunities for Inter-comparison Modeling Collaborations (poster). 40th annual North American SETAC meeting, Toronto, Ontario, Canada, Nov. 2019.
30. Urban, NR; Perlinger, JA; Khan, TR, Priyadarshini, M; **Friedman, CL**; Lin, H. Recovery of Lake Superior from historical PCB pollution (poster). 61st International Association for Great Lakes Research Conference, Toronto, Ontario, Canada, June 2018.
29. **Friedman, CL**. PCBs in the Arctic atmosphere: Determining important driving forces using a global atmospheric transport model (poster). 37th annual North American SETAC meeting, Orlando FL, Nov. 2016.
28. **Friedman, CL**. Assessing the influence of secondary organic versus primary carbonaceous aerosols on long-range atmospheric PAH transport (platform). 37th annual North American SETAC meeting, Orlando FL, Nov. 2016.
27. **Friedman, CL**. Simulating climate change and emissions impacts on atmospheric pollution in the Arctic (poster). Arctic Council Forum, University of Southern Maine, Portland, ME, October 2016.
26. **Friedman, CL**. Tracking the bioavailability, fate, and transport of persistent organic pollutants (POPs) using measurements and models. University of Maine School of Marine Science seminar series. Orono, ME, May 2016. **Invited talk.**
25. **Friedman, CL**. Measuring and modeling the environmental fate and transport of toxic organic contaminants. Maine Maritime Academy Ocean Studies seminar series. Castine, ME, February 2016. **Invited talk.**
24. **Friedman, CL**, Thackray, C, Selin, NE. Assessing the global and Arctic transport and fate of PCBs using the atmospheric chemical transport model GEOS-Chem (platform). DIOXIN, Madrid, Spain, September 2014.
23. **Friedman, CL**, Selin, NE. Climate change and POPs: air-sea interactions (platform). Gordon Research Conference: Oceans and Human Health, Biddeford, ME, June 2014. **Invited talk.**
22. **Friedman, CL**, Pierce, JR, Selin, NE. Assessing the influence of secondary organic aerosols on long-range atmospheric PAH transport (poster). American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 2013.
21. **Friedman, CL**, Zhang, Y, Selin, NE. Climate change and emissions impacts on atmospheric PAH

transport to the Arctic (platform). International Symposium on Polycyclic Aromatic Compounds, Corvallis, OR, Sep. 2013.

30. **Friedman, CL**, Zhang, Y, Selin, NE. Influence of future emissions and climate on atmospheric PAH transport (platform). 6th International GEOS-Chem Conference, Cambridge, MA, May 2013.
20. **Friedman, CL**, Selin, NE. Influence of future emissions and climate on PAH transport (poster). American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 2012.
19. **Friedman, CL**, Selin, NE. Influence of future emissions and climate on PAH transport (platform). 33rd annual North American SETAC meeting, Long Beach, CA, Nov. 2012.
18. Selin, NE; **Friedman, CL**. Modeling Arctic contamination by persistent organic pollutants: Informing governance in the context of global change (poster). American Geophysical Union Science Policy Conference, Washington DC, May 2012.
17. **Friedman, CL**; Selin, NE. Long-range transport of PAHs: A global 3D model analysis and evaluation of Arctic sources (platform). International Polar Year, Montreal, Quebec, CA, April 2012.
16. **Friedman, CL**; Selin, NE. Long-range transport of PAHs: A global 3D model analysis and evaluation of Arctic sources. Association of Polar Early Career Scientists (APECS) monthly seminar series, April 2012. Virtual poster presentation. **Invited**.
15. **Friedman, CL**. Combining models and measurements to track the fate and transport of persistent organic pollution. Trinity College Chemistry Seminar Series, Hartford, CT, March 2012. **Invited talk**.
14. **Friedman, CL**. Global atmospheric transport of PAHs: Model evaluation and implications for policy. URI Graduate School of Oceanography Marine and Atmospheric Chemistry Seminar Series, Narragansett, RI, Feb. 2012. **Invited talk**.
13. **Friedman, CL**; Selin, NE. Persistent organic pollution: Global transport and implications for policy. MIT Leading Technology and Policy Independent Activities Period, Cambridge, MA, Jan. 2012. **Invited talk**.
12. **Friedman, CL**; Selin, NE. A global 3-D model to simulate long-range transport of PAHs: Effect of climate on transport to the Arctic (poster). American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 2011.
11. **Friedman, CL**; Selin, NE. A global 3-D model to simulate long-range transport of PAHs: Application to Arctic contamination (platform). 32nd annual North American SETAC meeting, Boston, MA, Nov. 2011
10. **Friedman, CL**; Lohman, R. Contrasting PCDD/F and PBDE activities in biota, sediment, and the water column of Newark Bay, New Jersey (USA) (platform). 32nd annual North American SETAC meeting, Boston, MA, Nov. 2011.
9. **Friedman, CL**, Selin, NE. Modeling global atmospheric transport of PAHs with GEOS Chem (platform). 5th International GEOS-Chem meeting, Cambridge, MA, May 2011.
8. **Friedman, CL**; Lohmann, R. Using passive samplers to determine the fate and transport of dioxins and furans in Newark Bay, NJ, USA (poster). Gordon Research Conference, Environmental Sciences: Water, Holderness, NH, June 2010
7. **Friedman, CL**; Lohmann, R. Using passive samplers to determine the fate and transport of dioxins and furans in Newark Bay, NJ, USA (poster). 20th annual European SETAC meeting, Seville, Spain, May 2010

6. **Friedman, CL**; Lohmann, R. Polyethylene passive sampling to estimate bioavailability of sedimentary organic contaminants: a laboratory and field comparison (poster). 20th annual European SETAC meeting, Seville, Spain, May 2010
5. **Friedman, CL**; Lohmann, R. Using passive samplers to determine the fate and transport of dioxins and furans in Newark Bay, NJ (platform). 30th annual North America SETAC meeting, New Orleans, LA, Nov. 2009.
4. **Friedman, CL**; Lohmann, R; Burgess, RM; Perron, MM; Cantwell, MG. Resuspension of contaminated field sediments and effect on PCB partitioning (platform). 30th annual North America SETAC meeting, New Orleans, LA, Nov. 2009.
3. **Friedman, CL**; Burgess, RM; Perron, MM; Ho, KT; Cantwell, MG; Ryba, SA; McKinney, RA; Lohmann, R. Comparing polychaete bioaccumulation and passive sampler uptake to assess the effects of sediment resuspension on PCB bioavailability (poster). 29th annual North America SETAC Meeting, Tampa, FL, Nov. 2008.
2. **Friedman, CL**; Burgess, RM; Perron, MM; Ho, KT; Cantwell, MG; Ryba, SA; McKinney, RA; Lohmann, R. Comparing polychaete bioaccumulation and passive sampler uptake to assess the effects of sediment resuspension on contaminant bioavailability (poster). Gordon Research Conference, Environmental Sciences: Water, Holderness, NH, June 2008
1. **Friedman, CL**; Lemley, AT; Hay, AG. Degradation of chloroacetanilide herbicides by anodic Fenton treatment (poster). 228th ACS National Meeting, Philadelphia, PA, September 2004.

INVITED TEACHING LECTURES/ACTIVITIES

First Year Experience, Maine Maritime Academy, Castine, ME (2018)

Taught basic yoga poses and philosophy to a section of FYI

Institute of Curious Youth, Calais, ME (2018)

Engaged native tribal middle school students in chemistry activities relevant to the ocean and atmosphere.

Institute of Curious Youth, Calais, ME (2017)

Engaged native tribal middle school students in chemistry activities relevant to the ocean and atmosphere.

Maine Maritime Academy, Castine, ME (2016)

Computer Modeling and Simulation of the Marine Environment – guest lecturer

Michigan Technological University, Houghton, MI (2014)

Communicating Wicked Environmental Problems (UN5100) – guest lecturer

University of Rhode Island Graduate School of Oceanography, Narragansett, RI (2009)

Environmental Organic Chemistry – guest lecturer

SERVICE

Maine Maritime Academy

Yoga Club Faculty Advisor (Spring 2018 – present)

Development and maintenance of Ocean Studies departmental website (Spring 2016- present)

Professional Development Committee (Fall 2016 – present)
Library Committee (Spring 2016 – present; Chair: Fall 2018-)
Chair of Search Committee for an Assistant Professor of Marine Science (Spring 2018)
Learning Technology Committee (Spring 2018)
Search Committee for Public Services Librarian (Spring 2017)
Search Committee for Head Librarian (Fall 2016)

Scientific Peer Review: Journals

Archives of Environmental Contamination
Atmosphere
Atmospheric Chemistry and Physics
Atmospheric Environment
Atmospheric Research
Chemosphere
Environmental Geochemistry and Health
Environment International
Environmental Pollution
Environmental Science and Technology
Environmental Toxicology and Chemistry
Global Planetary Change
Integrated Environmental Assessment and Management
Nature Geoscience
Science of the Total Environment

Scientific Peer Review: Proposals

National Science Foundation
National Institutes of Health

Other

Institute for Curious Youth – led activities for native tribal ME middle schoolers (2017 & 2018)
Coordinated student activities for annual SETAC meeting in Boston, MA (2011)
Organized/hosted URI-GSO Marine and Atmospheric Chemistry weekly seminar series (2010)
North Atlantic Chapter (NAC) SETAC Board of Directors (2008-2010)

PROFESSIONAL DEVELOPMENT

Membership in Professional Societies

Society of Environmental Toxicology and Chemistry (SETAC)
American Chemical Society (ACS)
American Geophysical Union (AGU)
Association of Polar Early Career Scientist (APECS)
Earth Science Women's Network (ESWN)

Workshops/Short courses

National Association of Geoscience Teachers webinar: Sustaining Your Interdisciplinary Environmental and Sustainability Program: Opportunities and Resources 2018

Agilent Technologies, Inc.: Techniques in GCQQQ Applications 2018
Certificate of Completion for 40 hours of continuing education credits

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| National Science Foundation Days Hosted by the University of Maine at Orono, Bangor, ME | 2016 |
| SENCER – Science Education for New Civic Engagements and Responsibilities Hosted by Maine Campus Compact and Maine EPSCoR, University of Southern Maine, Portland, ME | 2016 |
| Preparing for an Academic Career in the Geosciences Hosted by On the Cutting Edge (NSF). UNLV, Las Vegas, NV http://serc.carleton.edu/NAGTWorkshops/careerprep/index.html | 2009 |
| Nanotechnology: Environmental Implications and Applications Hosted by NAC-SETAC and New England Society of Risk Analysis. Leominster, MA | 2009 |
| Sediment Toxicity Testing: Methods to Achieve Strong Data Sets and Interpret Results Hosted by NAC-SETAC. Bristol, RI | 2009 |

CRUISES

ICEALOT (International Chemistry Experiment in the Arctic Lower Troposphere).

Woods Hole, MA, USA to Tromsø, Norway, March 19 2008 – April 12 2008. Measured air and water concentrations of persistent organic pollutants across the Atlantic and in the Arctic.