1. **Joseph J. Vallino, Ph.D.**

Senior Scientist, The Ecosystems Center, Marine Biological Laboratory
jvallino@mbl.edu
http://eco37.mbl.edu
ORCID: 0000-0002-4184-4512
508-289-7648

2. **Education**

*University of California, Berkeley, CA*
B.S. Chemical Engineering, June 1983.

*California Institute of Technology, Pasadena, CA*
M.S. Chemical Engineering, June 1985. Advisor: Prof. Gregory Stephanopoulos.
Thesis: On-Line Estimation of the Oxygen-Mass-Transfer Coefficient and Other State Variables in a Chemostat.

*Massachusetts Institute of Technology, Cambridge, MA*
Ph.D. Chemical Engineering, February 1991. Advisor: Prof. Gregory Stephanopoulos.
Thesis: Identification of Branch-Point Restrictions in Microbial Metabolism Through Metabolic Flux Analysis and Local Network Perturbations.

3. **Professional appointments**

*California Institute of Technology, Pasadena, CA*
Research Assistantships, August 1983 - June 1985

*Massachusetts Institute of Technology, Cambridge, MA*
Research and Teaching Assistantships, August 1985 - February 1991

*Scripps Institution of Oceanography, UCSD, La Jolla, CA*
Mellon Postdoctoral Fellow, February 1991-1993

*Marine Biological Laboratory, Woods Hole, MA*
Lakian Postdoctoral Scholar, July 1993 – 1995
Postdoctoral Scholar, August 1995 – January 1997
Research Associate, January 1997 – May 1997
Assistant Scientist, June 1997 – August 2005
Associate Scientist, August 2005 – December 2011
Senior Scientist, December 2011 – Present

*Brown University, Providence, RI*
Adjunct Assistant Professor (MBL), Ecology and Evolutionary Biology, 2004-2010
Assistant Professor (MBL), Geological Sciences, 2010-2013

*University of Chicago, Chicago, IL*
Consortium for Advanced Science and Engineering (CASE) Senior Scientist at-Large, September 2018 – Present.

4. **Completed publications**

*a. Refereed journal articles*

**Vallino, J.J.** and Stephanopoulos, G. (1987). Intelligent sensors in biotechnology: applications for the monitoring of fermentations and cellular metabolism. *Ann. N.Y. Acad. Sci*. **506**, 415-430.

Stephanopoulos, G. and **Vallino, J.J.** (1991). Network rigidity and metabolic engineering in metabolite overproduction. *Science* **252**, 1675-1681.

**Vallino, J.J.** and Stephanopoulos, G. (1993). Metabolic flux distributions in *Corynebacterium glutamicum* during growth and lysine overproduction. *Biotechnol. Bioeng.* **41**, 633-646.

Wikner, J., **Vallino, J.J.**, Steward, G., Smith, D., and Azam, F. (1993). Nucleic acids from the host bacterium as a major source of nucleotides for three marine bacteriophages. *FEMS Microbiol. Ecol.* **12**, 237-248.

Ingram, K., C. S. Hopkinson, K. Bowman, H. Garritt and **J. Vallino**. (1994). From watershed to estuary: assessment of nutrient loading, retention and export from the Ipswich River Basin. *Biol. Bull*. **187**, 277-278.

**Vallino, J.J.** and Stephanopoulos, G. (1994). Carbon Flux Distributions at the Glucose 6-Phosphate Branch Point in *Corynebacterium glutamicum* during Lysine Overproduction. *Biotech. Prog.* **10**, 327-334

**Vallino, J.J.** and Stephanopoulos, G. (1994). Carbon Flux Distributions at the Pyruvate Branch Point in *Corynebacterium glutamicum* during Lysine Overproduction. *Biotech. Prog.* **10**, 320-326.

Hopkinson, C.S. and **Vallino, J.J.** (1994). Toward the Development of Generally Applicable Models of the Microbial Loop in Aquatic Ecosystems. *Microb. Ecol.* **28**, 321-326.

Alderman, D., B. Balsis, I. Buffam, R. Garritt, C. Hopkinson and **J. Vallino**. (1995). Pelagic metabolism in the Parker River/Plum Island Sound Estuarine System. *Biol. Bull*. **189**, 250-251.

Balsis, B., D. Alderman, I. Buffam, R. Garritt, C. Hopkinson and **J. Vallino**. (1995). Total system metabolism in the Plum Island Sound estuary. *Biol. Bull*. **189**, 252-254.

Hopkinson, C.S. and **Vallino, J.J.** (1995). The Relationship between Man's Activities in Watersheds and Rivers and Patterns of Estuarine Community Metabolism. *Estuaries* **18**, 598-621.

Uhlenhopp, A. G., J. Hobbie and **J. Vallino**. (1995). Effects of land use on the degradability of dissolved organic matter in three watersheds of the Plum Island Sound estuary. *Biol. Bull*. **189**, 256-257.

Carini, S., N. Weston, C. Hopkinson, J. Tucker, A. Giblin and **J. Vallino**. (1996). Gas exchange rates in the Parker River estuary, Massachusetts. *Biol. Bull*. **191**, 333-334.

**Vallino, J.J.**, Hopkinson, C.S., and Hobbie, J.E. (1996). Modeling Bacterial Utilization of Dissolved Organic Matter: Optimization Replaces Monod Growth Kinetics. *Limnol. Oceanogr.* **41**, 1591-1609.

Jay, D.A., Uncles, R.J., Largier, J., Geyer, W.R., **Vallino, J.**, and Boynton, W.R. (1997). A Review of Recent Developments in Estuarine Scalar Flux Estimation. *Estuaries* **20**, 262-280.

Hopkinson, C.S, Buffam, I., Hobbie, J., **Vallino, J.**, Perdue, M., Eversmeyer, B., Prahl, F., Covert, J., Hodson, R., Moran, M.A., Smith, E., Baross, J., Crump, B., Findlay, S., and Foreman, D. (1998). Terrestrial inputs of organic matter to coastal ecosystems: an intercomparison of chemical characteristics and bioavailability. *Biogeochemistry* **43**, 211-234.

**Vallino, J.J.** and Hopkinson, C.S. (1998). Estimation of Dispersion and Characteristic Mixing Times in Plum Island Sound Estuary. *Estuarine, Coastal and Shelf Science* **46**, 333-350.

Canfield, S., L. Claessens, C. Hopkinson, E. Rastetter and **J. Vallino**. (1999). Long-term effect of municipal water use on the water budget of the Ipswich River basin. *Biol. Bull*. **197**, 295-297.

Pease, K.M., L. Claessens, C. Hopkinson, E. Rastetter, **J. Vallino**, and N. Kilham. (1999). Ipswich River nutrient dynamics: preliminary assessment of a simple nitrogen-processing model. *Biol. Bull*. **197**, 289-290.

Kirkby, R., L. Claessens, C. Hopkinson, E. Rastetter, **J. Vallino**. (2000). Modeling the effects of land-use change on nitrogen biogeochemistry in the Ipswich watershed, Massachusetts. *Biol. Bull*. **199**, 218-219.

Perring, A., M. Williams, C. Hopkinson, Jr, E. Rastetter, and **J. Vallino**. (2000). Solute dynamics in storm flow of the Ipswich River basin: effects of land use *Biol. Bull.*, **199**, 219-221.

**Vallino, J.J.** and Stephanopoulos, G. (2000). Metabolic flux distributions in *Corynebacterium glutamicum* during growth and lysine overproduction. *Biotechnol. Bioeng*. **67**, 872-885.

**Vallino, J.J.** (2000). Improving marine ecosystem models: use of data assimilation and mesocosm experiments. *J. Mar. Res*. **58**, 117-164.

Hopkinson, C.S., **Vallino, J.J.** and Nolin, A. (2002). Decomposition of dissolved organic matter from the continental margin. *Deep-Sea Res. II*, **49**, 4461-4478.

**Vallino, J.J.** (2003). Modeling microbial consortiums as distributed metabolic networks. *Biol. Bull.*, **204**, 174-179.

Tobias, C.R., Cieri, M., Peterson, B.J. Deegan, L.A., **Vallino, J.** and Hughes, J. (2003). Processing watershed-derived nitrogen in a well-flushed New England estuary. *Limnol. Oceanogr.*, **48**, 1766-1778.

Giblin, A.E. and **Vallino, J**. (2003). The role of models in addressing coastal eutrophication problems. In: Canham, C. D., Cole, J. J. and Lauenroth, W. K. (eds), The Role of Models in Ecosystem Science. Princeton University Press, 327-343.

Filoso, S., **Vallino, J**., Hopkinson, C. and Rastetter, E. (2004). Modeling Nitrogen Processing and Transport in the Ipswich River Basin, Massachusetts, Using HSPF: Present Conditions and Future Scenarios. *J. Amer. Wat. Res. Assoc.*, **40**(5), 1365-1384.

Williams, M., Hopkinson, C., Rastetter, E., **Vallino, J.** (2004). N Budgets and Aquatic Uptake in the Ipswich River Basin, Northeastern Massachusetts. *Water Resources Research*, **40** (11), W11201, 12 pp.

Hopkinson, C.S. and **Vallino, J.J.** (2005). Efficient export of carbon to the deep ocean through dissolved organic matter. *Nature*, **433**, 142-145.

Williams, M., Hopkinson, C., Rastetter, E., **Vallino, J.** and Claessens, L. (2005). Relationships of land use and stream solute concentrations in the Ipswich River basin, Northeastern Massachusetts. *Water, Air and Soil Pollution*, **161**, 55-74.

**Vallino, J.J.**, Hopkinson, C.S., and Garritt, R.H. (2005). Estimating estuarine gross production, community respiration and net ecosystem production: A nonlinear inverse technique. *Ecol. Model.*, **187**, 281-296.

Wan, Z. and **Vallino, J.** (2005). An Inverse Ecosystem Model of Year-to-year Variations with First Order Approximation to the Annual Mean Fluxes. *Ecol. Model.*, **187**, 369-388.

Claessens, L., Hopkinson Jr, C., Rastetter, E. and **Vallino, J.** (2006). Effect of historical changes in land-use and climate on the water budget of an urbanizing watershed. *Water Resources Research*, **42**, W03426, doi:10.1029/2005WR004131.

Deegan, L.A., Bowen, J.L. , Drake, D., Fleeger, J.W., Friedrichs, C.T., Galván, K.A., Hobbie, J.E., Hopkinson, C., Johnson, J.M., Johnson, D.S., Lemay, L.E., Miller, E., Peterson, B.J. , Picard, C., Sheldon, S., **Vallino, J.**, Warren, R.S. (2007). Susceptibility of salt marshes to nutrient enrichment and predator removal. *Ecological Applications*, **17** (sp5), S42-S63.

Lyons, M.M., Lau, Y.-T., Carden, W.E., Ward, J.E., Roberts, S.B., Smolowitz, R., **Vallino, J.**, Allam, B. (2007) Characteristics of marine aggregates in shallow-water ecosystems: Implications for disease ecology. *EcoHealth,* **4**(4), 406-420, doi:10.1007/s10393-007-0134-0.

Wan, Z., **Vallino, J.J.**, and Peterson, B.J. (2008) Study of the inter-annual food web dynamics in the Kuparuk River with a first order approximation inverse model. *Ecol. Model.* **211** (1-2), 97-112, doi: 10.1016/j.ecolmodel.2007.08.022.

**Vallino, J.J.** (2010) Ecosystem biogeochemistry considered as a distributed metabolic network ordered by maximum entropy production. *Phil. Trans. R. Soc.* B, **365**, 1417-1427, doi:10.1098/rstb.2009.0272.

Zhao,L., Chen, C., **Vallino, J.**, Hopkinson, C., Beardsley, R.C., Lin, H., and Lerczak, J. (2010) Wetland-estuarine-shelf interactions in the Plum Island Sound and Merrimack River in the Massachusetts Coast. *JGR-Oceans*, **115**, C10039, 13 pp. doi:10.1029/2009JC006085.

**Vallino,J.J**. (2011) Differences and implications in biogeochemistry from maximizing entropy production locally versus globally. *Earth Syst. Dynam*. **2**, 69-85, doi: 10.5194/esd-2-69-2011

Xia, Li C., Steele, Joshua A., Cram, Jacob A., Cardon, Zoe G., Simmons, Sheri L., **Vallino**, **Joseph J.**, Fuhrman, Jed A., Sun, Fengzhu (2011) Extended local similarity analysis (eLSA) of microbial community and other time series data with replicates. *BMC Systems Biology*, **5**(Suppl 2):S15, 12 pp., doi: 10.1186/1752-0509-5-S2-S15

Dunaj, Sara; **Vallino, Joseph**; Hines, Mark; Gay, Marcus; Kobyljanec, Christine; Rooney-Varga, Juliette (2012) Relationships between soil organic matter, nutrients, bacterial community structure, and the performance of microbial fuel cells. *Environ. Sci. Technol.* **46** (3):1914-1922, doi: 10.1021/es2032532.

Algar, C.K. and **Vallino, J.J**. (2014) Predicting microbial nitrate reduction pathways in coastal sediments. *Aquat.Microb.Ecol*. **71** (3): 223-238, doi: 10.3354/ame01678.

Rastetter, E.B. and **Vallino, J.J.** (2015) Ecosystem's 80th and the Reemergence of Emergence. *Ecosystems* **18** (5), 735-739, doi: 10.1007/s10021-015-9893-6.

Chapman, E.J., Childers, D.L. and **Vallino, J.J.** (2016) How The Second Law of Thermodynamics has informed ecosystem ecology through its history. *BioScience* **66** (1), 27-39, doi: 10.1093/biosci/biv166.

**Vallino, J.J.** and Algar, C.K. (2016) Thermodynamics of marine biogeochemical cycles: Lotka revisited. *Ann. Rev. Mar. Sci.* **8**, 333-356, doi: 10.1146/annurev-marine-010814-015843.

Fernandez-Gonzalez, N., Huber, J.A., **Vallino, J.J**. (2016) Microbial communities are well adapted to disturbances in energy input. *mSystems* **1** (5), 15 pp., doi: 10.1128/mSystems.00117-16.

**Vallino, J.J**. and Huber, J.A. (2018) Using maximum entropy production to describe microbial biogeochemistry over time and space in a meromictic pond. *Frontiers in Environmental Science* **6**, 100, 22 pp., doi: 10.3389/fenvs.2018.00100

Stewart, L.C., Algar, C.K., Fortunato, C.S., Larson, L., **Vallino, J.J**., Huber, J.A., Butterfield, D.A. and Holden, J.F. (2019) Metabolic activity and local hydrology define methanogen community size and composition in vents. *ISME J*, 11 pp., doi: 10.1038/s41396-019-0382-3

**Vallino, J.J.** and Tsakalakis, I. (2020) Phytoplankton temporal strategies increase entropy production in a marine food web model. *Entropy*, **22** (11), 1249, 25 pp., doi: 10.3390/e22111249.

Fortunato, C. S., D. A. Butterfield, B. Larson, N. Lawrence-Slavas, C. K. Algar, L. Zeigler Allen, J. F. Holden, G. Proskurowski, E. Reddington, L. C. Stewart, B. D. Topçuoğlu, **J. J. Vallino**, and J. A. Huber. 2021. Seafloor incubation experiment with deep-sea hydrothermal vent fluid reveals effect of pressure and lag time on autotrophic microbial communities. *Applied and Environmental Microbiology*: AEM.00078-00021, doi:10.1128/aem.00078-21.

Tsakalakis, I., M. J. Follows, S. Dutkiewicz, C. L. Follett, and **J. J. Vallino**. 2022. Diel light cycles affect phytoplankton competition in the global ocean. *Global Ecology and Biogeography*, 31 (9), 12 pp., doi: 10.1111/geb.13562

Charles Hopkinson, Nathaniel B. Weston, **Joseph J. Vallino**, Robert H. Garritt, Inke Forbrich. 2025.Comparative Metabolism and Blue Carbon Sequestration of Two Wetland-Dominated Estuaries. *Ocean-Land-Atmos Res*. **4**;0091, 22 pp.: doi:10.34133/olar.0091

Sabrina M Elkassas, Caroline S Fortunato, Sharon Grim, David A. Butterfield, James F Holden, **Joseph J Vallino**, Christopher Algar, Lisa Zeigler Allen, Benjamin Larson, Giora Proskurowski, Emily Reddington, Lucy Stewart, Begum Topcuoglu, Julie A. Huber. 2025.

Metabolic and Population Profiles of Active Subseafloor Autotrophs in Young Oceanic Crust at Deep-Sea Hydrothermal Vents. *Applied and Environmental Microbiology*, **91**(11):e01868-25, doi: 10.1128/aem.01868-25

**Joseph J. Vallino**, Olivia M. Ahern, Julie A. Huber. 2025. Deriving microbial food web structure by maximizing entropy production over variable timescales. *Interface Focus*, **15** (6) 20250023, doi: 10.1098/rsfs.2025.0023.

Elaine Luo, Ngoc Dung Pham, Timothy J Rogers, Md Moinuddin Sheam, Bayleigh E Benner, **Joseph J Vallino**, Gareth Trubl, & Julie A Huber. 2026. Quantitative stable isotope probing (qSIP)-informed metagenomics identifies viruses infecting chemoautotrophs. *Nat. Commun*., **17**, 5201, doi: 10.1038/s41467-026-71833-x

Ashley N Bulseco, Wenzhou Yan, Julie A Huber, and **Joseph J. Vallino**. 2026. Growth characteristics of natural microbial populations are skewed towards bacteria with low specific growth rates. *Microbiology Spectrum* **14** (9):e02193-26, doi: 10.1128/spectrum.02193-26

*b. Submitted journal articles*

Olivia M. Ahern, Ashley Bulseco, Amy Smith, J.L. Weissman, Joseph J. Vallino, Julie A. Huber. 2026. Aquatic bacterial metabolic rates from RNA quantitative stable isotope probing (RNA-qSIP) depend on experimental design. *Appl. Environ. Microbiol*. (in revision) (bioRxiv 2026.07.28.739216; doi: 10.64898/2026.07.28.739216)

*c. Non-refereed journal articles*

**Vallino, J.J.**, C. S. Hopkinson, R. Garritt, J. Tucker. (1999). A non-linear inverse technique to estimate estuarine ecosystem metabolism from whole system oxygen measurements, Proceedings of the 3rd International Symposium on Ecohydraulics, Salt Lake City, UT, July 1999 (CD ROM)

Pontius Jr, R.G., L. Claessens, C. Hopkinson Jr, A. Marzouk, E.B. Rastetter, L.C. Schneider, **J.J. Vallino**. (2000). Scenarios of land-use change and nitrogen release in the Ipswich watershed, Massachusetts, USA. in Parks, B.O., K.M. Clarke, M.P. Crane, editors. 2000. Proceedings of the 4th international conference on integrating geographic information systems and environmental modeling: problems, prospects, and needs for research; 2000 Sep 2-8; Boulder, CO. Boulder: University of Colorado, Cooperative Institute for Research in Environmental Science. (www and CD ROM).

*d. Books/monographs*

*e. Chapters in books*

**Vallino, J.J.** and Stephanopoulos, G. (1990). Flux determinations in cellular bioreaction networks: applications to lysine fermentations. In: Frontiers in Bioprocessing. Sikdar, S. K., Todd, P. W., and Bier, M. (Eds.), CRC Press, Florida, 205-219.

**Vallino, J.J.** and Stephanopoulos, G. (1990). Intracellular flux analysis as means of identifying limiting nodes in amino acid fermentations. In: Proc. - Eur. Congr. Biotechnol., 5th, Vol. 2., Christiansen, C., Munck, L., Villadsen, J. (Eds.), Munksgaard, Copenhagen, Den. 1063-1066.

Bowden, W. B., B. J. Peterson, L. A. Deegan, A. D. Huryn, J. P. Benstead, H. Golden, M. Kendrick, S. M. Parker, E. Schuett, **J. J. Vallino**, and J. E. Hobbie. (2014) Ecology of Streams of the Toolik Region. In J. E. Hobbie and G. W. Kling, editors. *Alaska's Changing Arctic: Ecological Consequences for Tundra, Streams, and Lakes*. Oxford University Press, New York, pp. 173-237.

**Vallino, J.J**., Algar, C.K., Fernandez Gonzalez, N., Huber, J.A. (2014) Use of receding horizon optimal control to solve MaxEP-based biogeochemistry problems. In *Beyond the Second*

*Law: Entropy Production and Non-Equilibrium Systems*, Dewar, R.C., Lineweaver, C., Niven, R. and Regenauer-Lieb, K., (eds), Springer, pp 337-359, doi: 10.1007/978-3-642-40154-1_18.

*f. Book reviews*

*g. Abstracts (I$^{st}$ Authored only)*

"Metabolic Perturbations as a Means of Identifying Rate Limiting Fluxes in Amino Acids Production," Annual Meeting of the American Institute of Chemical Engineers, San Francisco, CA, November 1989.

"Elucidation of the Enzyme Control Architecture Associated with Metabolic Rigidity in Lysine Synthesis," Annual Meeting of the American Institute of Chemical Engineers, Chicago, IL, November 1990.

"A Bioenergetic Analysis of Bacterial Utilization of Dissolved Organic Matter", American Society of Limnology and Oceanography, Reno, NV, June 1995.

"Mesocosm Study to Assess Impact of DOM Input on Estuarine Food Webs", 13th International Estuarine Research Federation, Corpus Christi, TX, November 1995.

"Synthesis of Whole System Metabolic Measurements with an Estuarine Model to Assess Heterotrophic Processes", American Society of Limnology and Oceanography, Santa Fe, NM, February 1997.

"Seasonal patterns in estuarine metabolism from whole system measurements of oxygen: A pseudo-inverse technique", Estuarine Research Federation, Providence, RI, October 1997.

"Do terrestrial organic matter inputs stabilize aquatic food webs?", American Society of Limnology and Oceanography, St. Louis, MO, June 1998.

"Improving Marine Ecosystem Models: Use of Data Assimilation and Mesocosm Experiments", American Society of Limnology and Oceanography, Santa Fe, NM, February 1999.

"A non-linear inverse technique to estimate estuarine ecosystem metabolism from whole system oxygen measurements", 3rd International Symposium on Ecohydraulics, Salt Lake City, UT, July 1999.

"Use of a $^{15}$N Enrichment Experiment for the Development and Calibration of an Estuarine Biogeochemistry Model", Estuarine Research Federation, New Orleans, LO, September 1999.

"A Thermodynamically Constrained Metabolic Ecosystem Model", American Society of Limnology and Oceanography, Copenhagen, Demark, June 2000.

"Model Evaluation Of Land-Use Transformations On Nutrient Dynamics In The Ipswich River, Ma", American Society of Limnology and Oceanography, Albuquerque, NM, February 2001.

"Using Whole-System 15N-Tracer Experiments To Improve Estuarine Biogeochemistry Models", Estuarine Research Federation Biannual Meeting, St. Pete Beach, FL, November, 2001.

"Use of methanotrophic microcosms, tag sequencing and thermodynamic metabolic models to examine structure-function relationships", Ocean Sciences Meeting, Salt Lake City, UT, Feb 2012.

"Using metagenomic and metatranscriptomic observations to test a thermodynamic-based model of community metabolic expression over time as space", Ocean Sciences Meeting, New Orleans, LA, Feb 2016.

"Comparing metagenomic and metatranscriptomic observations over time and space in a meromictic pond to predictions from a thermodynamic-based model of community metabolic expression", Ocean Sciences Meeting, Portland, OR, Feb 2018.

"The Importance of Incorporating Planktonic Temporal Strategies in Marine Ecosystem Models", Ocean Sciences Meeting, San Diego, CA, Feb 2020.

"An approach to determine trait values by maximizing entropy production over time", Fifth Traits Workshop, Knoxville, TN, Jan 2022

"Using thermodynamic models, stable isotope probing, and genomics to understand microbial food web structure and function", Mallorca, ES, Jun 2023

"Characterizing Bacterial Specific Growth Rates Using Experimental Microcosms and Trait-Based Modeling", Ocean Sciences Meeting, New Orleans, LA, Feb 2024

"Combing optimized trait-based modeling with stable isotope probing and genomics to understand microbial food web structure and function", 7th Workshop of Trait-based Approaches to Ocean Life, Pacific Grove, CA, Aug 2025

"Combing thermodynamic-based modeling with stable isotope probing and genomics to understand substrate preferences and predator-prey connectivity in microbial food webs", Ocean Sciences Meeting, Glasgow, Scotland, Feb 2026.

*h. Invited lectures*

"Algorithmic Sensor for the Monitoring of Cellular Metabolism," Frontiers in Bioprocessing Conference, Boulder, CO, June 1987.

"A Bioenergetic Approach to Modeling Microbial Food Webs," NATO Workshop on Ecosystem Modeling for the Black Sea, Sofia, Bulgaria, March 1994.

"A Bioenergetic Approach to Modeling Microbial Food Webs", Marine Chemistry Seminar Series, Woods Hole Oceanographic Institute, Woods Hole, MA, May 1995. This seminar was also given at Tufts, Yale, and Harvard Universities.

"A Bioenergetic Analysis of Bacterial Utilization of Dissolved Organic Matter", Gordon Research Conference: Estuarine and Coastal Processes, Plymouth, NH, June 1995.

"Approaches to Modeling DOM Based Food Webs: LMER PISCES Modeling Effort", Modelling Nitrogen in Coastal Ecosystems (Sea Grant workshop), MIT, Cambridge, MA, January 1996.

"Developing estuarine ecosystem models." Seminar course on Estuarine Ecosystem Dynamics, University of New Hampshire, NH, April 1998.

"Ecosystem biogeochemistry viewed as an optimized metabolic network", Boston University, Boston MA, April 2001.

"Viewing Ecosystem Biogeochemistry as an Optimized Metabolic Network", Institute of Ecosystem Studies, Millbrook, NY, November 2001.

"Viewing Microbial Biogeochemistry as a Distributed Metabolic Network", University of Rhode Island, Narragansett, RI, April 2002.

"Viewing Microbial Biogeochemistry as a Distributed Metabolic Network", Outcomes of Genome-Genome Interactions, Woods Hole, MA, May 2002.

"Modeling Microbial Consortiums as Distributed Metabolic Networks", American Society of Limnology and Oceanography, Salt Lake City, UT, February 2003.

"Modeling Diagenetic Processes As An Optimized Metabolic Network". American Society of Limnology and Oceanography, Honolulu, HI, February 2004.

"Is ecosystem biogeochemistry governed by nonequilibrium thermodynamics and resource allocation constraints?" Gordon Conference on *Metabolic Basis of Ecology*, Bates College, ME, July 2004.

"Viewing microbial biogeochemistry as a distributed metabolic network governed by thermodynamics". University of New Mexico, Albuquerque NM, November 2004.

"Viewing microbial biogeochemistry as a distributed metabolic network governed by thermodynamics". Lawrence Livermore National Laboratory, Livermore CA, December 2004.

"Does non-equilibrium thermodynamics govern metabolic network expression in microbial communities?" Department of Marine Sciences Seminar, University of Georgia, Athens, GA, Dec 2005.

"Does non-equilibrium thermodynamics govern metabolic network expression in microbial communities?" Microbial Ecology Workshop, Mathematical Biosciences Institute, Ohio State University, Columbus, OH, May 2006.

"Can the coordination and expression of distributed microbial metabolic networks be explained by the theory of maximum entropy production?" Department of Marine Biology, Avery Point, University of Connecticut, Avery Point, CT, Dec 2006.

"Can the coordination and expression of distributed microbial metabolic networks be explained by the theory of maximum entropy production?" American Society of Limnology and Oceanography, Santa Fe, NM, February 2007.

"Relationships between microbial consortia and microbial metabolic networks" American Society of Microbiology General Meeting, Toronto, Canada, May 2007.

"Can Dynamic Trophic Structures Be Captured in Structurally Fixed Models?" Ocean Carbon and Biogeochemistry Workshop, Woods Hole, MA, July 2007.

"How can the principle of maximum entropy production improve modeling of watershed hydrology and biogeochemistry?" CUAHSI Capstone Symposium, Vancouver, Canada, Aug 2009.

"Use of the maximum entropy production principle for modeling microbial biogeochemistry." Maximum Entropy Production Workshop, Jena, Germany, May 2008.

"Modeling Groundwater Biogeochemistry by Maximizing Entropy Production Averaged Over Space and Time." Maximum Entropy Production Workshop, Jena, Germany, May 2009.

"Microbial Biogeochemistry", Trophos Energy, Cambridge MA, Oct 2009.

"Hydrodynamic and Biogeochemical Modeling at the Plum Island Ecosystems (PIE) LTER site", Woods Hole Oceanographic Institution, COFDL Seminar, Woods Hole, MA, March 2010.

"Differences and implications of maximizing entropy production locally versus globally" Non-Equilibrium Thermodynamics and MEP in the Earth system, Jena, Germany, May 2010.

"How do living systems differ from fire? Microbial biogeochemistry and the maximum entropy production principle", Biology Department Seminar, UMass Lowell, Oct 2010.

"Use of receding horizon optimal control to solve MEP-based biogeochemistry problems", Workshop on Maximum Entropy Production, Canberra, Australia, September 2011.

"Maximum Entropy Production as a descriptor of microbial chemistry: How does life differ from fire?" Chemistry Department Seminar, Wake Forest University, Winston-Salem, NC, Oct 2012.

"Modeling microbial biogeochemistry as a maximum entropy production process", Plenary, Center for Dark Energy Biosphere Investigations, All-Hands Meeting, Monterey Bay, CA, Oct 2012.

"Maximum Entropy Production as a descriptor of microbial chemistry: How does life differ from fire?", Department of Marine Sciences, University of Georgia, Athens, GA, Apr 2013.

"Maximum Entropy Production as a descriptor of microbial chemistry: How does life differ from fire?", Department of Microbiology, University of Massachusetts Amherst, MA, Nov 2013.

"Maximum entropy production as a framework for understanding how living systems evolve, organize and function", American Geophysical Union Fall Meeting, San Francisco, CA, Dec 2014.

"Living systems defined in the context of maximum entropy production and information: A computational approach", Computations in Science Seminars, University of Chicago, IL, Apr 2015.

"Using thermodynamic objective criteria for understanding distributed metabolic networks that arise from microbial communities", Biological & Environmental Sciences colloquium series, URI, RI, Mar 2016. and at WHOI in Mar 2016.

"Using metagenomic and metatranscriptomic observations to test a thermodynamic-based model of community metabolic expression over time and space", UGA Marine Sciences, Athens GA, Nov 2016 and at UCI Department of Earth System Science, Irvine, CA, May 2017.

"Rules of Life: Living Systems Organize, Adapt, Cooperate and Compete to Maximize Energy Dissipation Over Time and Space", University of Miami Biochemistry and Molecular Biology Dept., Miami FL, Oct 2019.

"Using the maximum entropy production principle to understand and predict microbial biogeochemistry", Annual meeting of the Society of Mathematical Biology, Virtual, June 2021

"Using the maximum entropy production principle to understand and predict microbial biogeochemistry" Dalhousie University, Halifax, Canada, Oct 2022

"A change of perspective in understanding and modeling marine biogeochemistry using entropy production; it's the law, probably", WHOI, Biology Dept., Feb 2025

## 5. Research Grants

*a. Current grants*

NSF-OCE-2224608, LTER: Plum Island Ecosystems, the impact of changing landscapes and climate on interconnected coastal ecosystems, Aug 2022-Jul 2028, **Co-PI**, $7,649,999

Simons Foundation-CBIOMES 549941FY22, Thermodynamically guided trait-based ocean biogeochemistry modeling, Jul 2022-Jun 2027, **Lead-PI**, $1,183,671.

*b. Completed grants*

NSF-DEB-9726862, W/WS: Integrated, Ecological-Economic Modeling of Watersheds and Estuaries at Multiple Scales, Oct 1997-Sep 2002, **Co-PI**, $815,000.

NSF-OCE-9726921. LTER: Plum Island Sound Comparative Ecosystem Study (Pisces) Effects of Changing land Cover, Climate and Sea Level on Estuarine Trophic Dynamics, Jul 1998-Jun 2004, **Co-PI**, $4,646,609.

NSF-EAR-9807632, (EGB) Predictions of Bioavailability of Riverine Dissolved Organic Matter from Bulk Measures of Geochemical Composition Across Landscape and Continental Gradients, Oct 1998-Sep 2000, **Co-PI**, $259,483.

NSF-DEB-9815598. Ecosystem Controls on the Biogeochemical Processing of Watershed-Derived Nitrogen in Tidal Rivers, Sep 1999-Aug 2002, **Co-PI**, $823,000.

NSF-EAR-0083839, BIOCOMPLEXITY – INCUBATION ACTIVITY: Quantitative Description of The Response of a Complex System to Disturbance: Subsurface Microbial Communities and Chemical Contaminants, Oct 2000-Mar 2003, **Co-PI**, $67,211.

NSF-OPP-9911278, Aquatic Ecosystem Responses to Changes in the Environment of an Arctic Drainage Basin, Jul 2000-Jun 2005, **Co-PI**, $3,257,870.

NSF-DEB-0213767, Trophic Cascades and Interacting Control Processes in a Detritus-Based Aquatic Ecosystem, Oct 2002-Sep 2006, **Co-PI**, $2,699,971.

NSF-0301231, Controlled Environment Facilities for Examination of the Effects of Climate Change and Human Land Use on Terrestrial and Aquatic Ecosystems. (Equipment Grant), Jul 2003-Jun 2005, **Co-PI**, $240,000 plus $120,000 MBL cost share.

NSF-EF-0429004, Linking Marine Pathogens to Molluscan Shellfish: The Ecological Role of Marine Aggregates, Sep 2004-Aug 2007, **Co-PI**, $1,053,000.

NOAA-CICEET, Effectiveness of Reactive Barriers for Reducing N-Loading to the Coastal Zone, Sep 2004-Aug 2007, **Lead PI**, $210,000.

NASA- NNH04ZSS001N Astrobiology, Do thermodynamic goal functions describe microbial biogeochemical dynamics?, Aug 2005-July 2006, **Lead PI**, $74,000.

NSF-OCE-0423565, Plum Island Ecosystems LTER, Aug 2004-Jul 2010, Co-I, $5,738,000.

NSF-DEB-0542682, Collaborative Research: Benthic Microalgal Regulation of Carbon and Nitrogen Turnover in Land Margin Ecosystems: A Dual Stable Isotope Tracer Approach, Feb 2006-Feb 2012, **Co-PI**, $92,827.

NSF-CBET-0756562: Modeling Microbial Biogeochemistry in Permeable Reactive Barriers, May 2008-Apr 2012, **Lead PI**, $300,000.

NSF-OCE-0852263: Collaborative Research: Environmental Controls on Anammox and Denitrification Rates in Estuarine and Marine Sediments, Jul 2009-Jun 2012, **Co-PI**, $482,144.

NSF-OCE-1058747, Plum Island Ecosystems LTER, Oct 2010-Sep 2012, **Co-PI**, $2,213,777.

NSF-EF-0928742: Theory: Biological systems organize to maximize entropy production subject to information and biophysicochemical constraints, Sep 2009-Aug 2013, **Lead PI,** $750,000.

NOAA/MIT Sea Grant: Microbial Community Composition of Permeable Reactive Barriers: Who is Really Doing the Work?, Feb 2012-Jan 2015, **Co-PI**, $26,359 sub award.

DOE-EMSL-48391: Integration of Pore-Scale Simulations and Multi-Omics Data to Develop Insights into Functional Heterogeneity in Microbial Communities, Oct 2014-Sep 2015, **Co-PI**, Computing: Cascade (Atipa 1440 Intel Xeon-Phi Node FDR-Infiniband Linux Cluster): 70,000 hrs.

NSF-OCE-1238212: LTER-PIE: Interactions Between External Drivers, Humans and Ecosystems in Shaping Ecological Process in a Mosaic of Coastal Landscapes and Estuarine Seascapes, Oct 2012-Sep 2016, **Co-PI**, $4,171,697.

MOORE Foundation-MMI 3297: Functional Dynamics, Interactions and Biogeochemical Impact of Chemolithoautotrophic Subseafloor Microbial Ecosystems at Axial Seamount, a Mid-Ocean Ridge Cabled Observatory, Jul 2012-Jun2017, **Co-PI**, $2,258,547.

NOAA/WHOI Sea Grant: The impacts of increased nitrogen loadings on decomposition in salt marshes: Does eutrophication enhance marsh accretion or erosion? May 2014-Apr 2016, **Co-PI**, $119,998 (plus $ 62,360 matching).

Anonymous Donor: Continuous production of methane from algae lacking cell walls. Oct 2014 – Sep 2016, **Co-PI**, $360,000.

NSF-GEO-1451356: Application of thermodynamic theory for predicting microbial biogeochemistry, Apr 2015-Apr 2016, **Lead PI**, $203,658.

DOE-EMSL-JGI-49028: 3D Reality Check: Developing Structural Support for Predicting Microbial Function and Interpreting Microbial "Omics" Data, Jul 2015-Jun 2016, **Co-PI**, JGI Genomic and transcriptomic sequencing of *Methanosarcina barkeri str. Fusaro.*

NSF-DEB-1841599, EAGER SitS: Developing a Next Generation Modeling Approach for Predicting Microbial Processes in Soil, Jan 2019-Dec 2020, **Lead PI**, $300,000.

NSF-OCE-1558710, Collaborative Research: Predicting the Spatiotemporal Distribution of Metabolic Function in the Global Ocean, Apr 2016-Feb 2020, **Lead PI**, $687,302.

NSF-DBI- 2128820, Controlled Environment Facilities for the Marine Biological Laboratory, Dec 2021-Jan 2023, **Co-PI**, $437,022.

NSF-OCE-1637630, LTER-Plum Island Ecosystems: Dynamics of coastal ecosystems in a region of rapid climate change, sea-level rise, and human impacts, Oct 2016-Sep 2022, **Co-PI**, $6,761,476.

Simons Foundation-CBIOMES 549941, Thermodynamically Constrained Metabolic Networks for Ocean Modeling, Jul 2017-Jun 2022, **Lead-PI**, $993,229.

NSF-DEB-1655552, Investigating the connectivity of microbial food webs using thermodynamic models, stable isotope probing and genomics, Aug 2017-Jul 2024, **Lead PI**, $754,019.

DOE-JGI-CSP-509931, Linking genes to models: Unraveling microbial food web connectivity through multi-substrate RNA stable isotope probing, omics, and metabolic models, Sep 2023-Aug 2025, **Co-PI** (Lead PI is postdoctoral student), Metagenomic and metatranscriptomic sequencing.

*c. Proposals submitted*

**6. Service**

*a. To the MBL*

Fellowships and Research Awards Committee, Jan 2006-Dec 2008
Bay Paul Center, Assistant Scientist search committee, Nov 2006
Director's Counsel, Mar 2015 – Mar 2017
MBL IT Advisory Committee, Aug 2015 – Present
Search Committees: Assistant Scientist MBL, Jan 2018; Hibbitt Fellow, Feb 2018; Assistant Scientist MBL, Mar 2019, Assistant and Senior Scientists, Ecosystems Center, Dec 2020.
Science Council, Nov 2019 - Present
Promotion Committee, Bay Paul Center, Jan 2021.
Director of Research Search Committee, Mar 2021.
Postdoc association liaison, Apr 2023 - Present
Promotion Committee, Ecosystems Center, May 2024.
Task force on faculty compensation for teaching, Oct 2024
Whitman Fellowship Review committee, Jan 2025
Promotion Committee, Chair, Bay Paul Center, Oct 2025

*b. To the university (Brown)*

Research Committee for Brown/IBM High Performance Computing Center, March-October 2009.

Energy/Environment Working Group, Office of the Vice President for Research, December 2009.

*c. To the university (Chicago)*

Served on the Planning Committee for the MBL and UChicago May 2014 retreat.

Coastal Nitrogen Synthesis Charette, Sep 2014.

Microbiome Center Collaboratorium, Jun 2016.

Beacon Project, Microbiome Center, Nov 2020.

*d. To the profession*

NATO Science of Stability Program: Advisory committee for the TU-Black Sea Project, 1994 - 1995.

NSF JGOFS-Southern Ocean Modeling panel member, 1995.

Editorial Board, *Mangroves and Salt Marshes*, 1998 - 1999.

EPA Water and Watersheds Program panel member, 1999.

Editorial Board, *Wetlands Ecology and Management*. 1999 - 2001.

NSF Biocomplexity Math/Theory/Computation panel member, 2000.

NOAA Coastal Hypoxia Research Program panel member, 2005.

NSF Ecosystems Cluster panel member, 2006.

LTER Site Review Committee, Dry Valleys, Antarctica. Jan 2008.

*Nature* Reader Panel. 2008 - 2009.

Review Editor, *Aquatic Microbial Ecology*. 2007 - Present.

NSF Advancing Theory in Biology panel member, 2010 and 2011.

NSF Center for Coastal Margin Observation and Prediction site review committee, 2012.

DOE SBR SFA review panel, 2018.

Session Chair/Organizer for:

*Novel Approaches to Modeling Food Web and Ecosystem Biogeochemistry*, ASLO, Salt Lake City, UT, Feb 2003.

*Ecology and Population Biology*, MBL General Scientific Meeting, Woods Hole, Aug 2003.

*Understanding and Modeling Aquatic Ecosystems Using Fundamental Laws*, ASLO, Santa Fe, NM, Feb 2007.

Reviewed numerous proposals for: NSF, NOAA, UNH CICEET, EPA, DOE, Sea Grant, and Hudson River Foundation.

Reviewed manuscripts for: *American naturalist, Aquatic Microbial Ecology, Astrobiology, Biogeochemistry, Biological Bulletin, Biotechnology & Bioengineering, Biotechnology Progress, Cell Reports Physical Science, Chemical Geology, Deep-Sea Research, Ecological Applications, Ecological Modelling, Ecological Monographs, Ecosphere, Ecosystems, Entropy*, *Environmental Microbiology*, *Environmental Modeling Software, Estuaries, Estuarine Coastal and Shelf Science*, *Frontiers in Microbiology*, *Geology*, *Global Biogeochemical Cycles*, *ISME J*, *Journal of Geophysical Research, JGR Biogeosciences*, *Journal of Marine Research, Journal of Marine Systems*, *Limnology and Oceanography, L&O Methods, Marine Ecology Process Series*, *Microbiology*, *Oceanography, PeerJ*, *Philosophical Transactions of the Royal Society B: Biological Sciences, Proceedings of the National Academy of Sciences, Processes*.

Organizations: Society for Mathematical Biology, American Geophysical Union; Association for the Sciences of Limnology and Oceanography, Coastal and Estuarine Research Federation, American Society of Microbiology.

*e. To the community*

WGBH interview for *Fresh Water, Salt Water – Part III – Simple Solutions*. Use of permeable reactive barriers for groundwater bioremediation.

Finding Genius Podcast, *Marine Microbial Musing*, Jan 2020.

**7. Academic honors, fellowships, honorary societies**

Outstanding Sophomore Award, American Institute of Chemical Engineers, UCLA. 1981.

Northern California Section Award for AICHE. 1983.

Corning Glass Fellowship, Caltech. 1983-1984.

Mellon Postdoctoral Fellowship Award at Scripps Institution of Oceanography. 1991-1993.

Lakian Postdoctoral Scholar Award at Marine Biological Laboratory, 1993-1994.

Vallino and Stephanopoulos (1993) selected as one of the top 20 papers of special significance over the last 40 years of publication in *Biotechnology & Bioengineering*. 2000.

## 8. Teaching

*a. Marine Biological Laboratory, Woods Hole, MA*

Semester in Environmental Science Program (see http://www.mbl.edu/SES)

*Course Instructor*, Microbial Methods in Ecology (fall 1999-2025): Undergraduate course combines lectures on microbial biogeochemistry and ecology with laboratory methods. Lectures and labs on bacterial counts, leucine-$^{14}$C bacterial productivity, hydrogen sulfide and methane production in Winogradsky columns, extracellular enzyme assays, bacterial grazers, bacteria-phytoplankton competition, and PCR (see http://ecosystems.mbl.edu/SES/MicrobialMethods).

*Course Instructor*, Microbial Methods in Ecology (fall 2026-present): New three week module format that meets M-F, 9-5 in SES.

*SES Undergraduate Research Projects and REU's, Advisor to* (*since 2015 only*):

Ruby An (2015) A2M: Experimental and modeling approaches to optimize an algae-to-methane coupled bioreactor system. (U. of Chicago, Metcalf).

Petra Byl (2015) Assessing Microbial Coordination over Space and Time in Siders Pond. (U. of Chicago, Metcalf).

Jessie Yang (2015) Effect of microbial fuel cells on nitrogen removal processes in wastewater organic matter.

Gabriela Atsepoyi (2015) Comparison of microbial respiration between heated and control plots in the Harvard Forest soil warming experiment.

Emily Geoghegan (2015) Understanding decomposition of organic matter in anaerobic environments: improving breakdown of algal mass in A2M methanogenic bioreactor.

Emily Okikawa (2015) The importance of microbial mats versus "pink berries" in altering nutrient cycles between sediments and the water column in Little Sippewissett marsh.

Petra Byl, **University of Chicago**, undergraduate project (2016) Assessing microbial metabolic function and circadian rhythms over time and space in Siders Pond.

Catherine Ballali, Earlham College (2016) Can a microbial fuel cell be used to harness electricity from algal biomass?

Olivia Bisposs, Earlham College (2016) Ocean Acidification and its effect on Phytoplankton growth.

Rachel Clifford, Franklin & Marshall College (2016) Importance of Structure to Function and Productivity of Pink Berry Bacterial Consortium.

Emi Lemberg, **University of Chicago** (2017) Microbial Fuel Cells for Improved Bioremediation.

Sarah Pope, Wheaton College (2017) FISHing for sulfate reducing microbes in Siders Pond, a meromictic lake.

Wenzhuo Yang, Allegheny College (2018) Are Microbial Community Inherently Unstable?

Rohan Guha, **University of Chicago** (2019) Anaerobic salt marsh microbial consortia remain stable over time when exposed to high nitrate concentrations (Metcalf Student).

Alexandria Schmidt, **University of Chicago** (2023) Competition Between Sulfate Reducers and Methanogens in Siders Pond

Hoang Luu, Rhodes College (2024) The Importance of Protists and Viruses in Bacterial Mortality Across Anaerobic and Aerobic Environments in Siders Pond

Cameron Johnson, Bethune-Cookman University (2024) Examining wildfire survivorship & post-fire metabolism within forest soil microbiomes

*Thesis Committees*
Jennifer Bowen. Boston University, Ph.D. Program, 2002-2007.
Yawei Luo. Brown University, Ph.D. Program, 2007-2009.
Sara Schloth, UMass Lowell, M.S. Program, 2010-2012
Angus Angermeyer, Brown University, Ph.D. Program, 2014-2017.
Kadir Bice, University of Georgia, Ph.D. Program, 2020-2024

*Postdoctoral Students Mentored*
Zhenwen Wan (2002-2004)
Lora Harris (2005-2007)
Liuzhi Zhao (2006-2009)
Nuria Fernandez-Gonzalez (2010-2014)
Chris Algar (2010-2014)
Aboozar Tabatabi (2017-2019)
Ashley Bulseco-McKim (2018-2019)
Ioannis Tsakalakis (2019-2023)
Amy Smith (2020-2021)
Olivia Ahern (2021-Present)

*b. Brown University, Providence, RI*

Co-instructor, Geomicrobiology (GEOL1950F), fall 2011. Course examined the influence of microbes in geological and environmental processes by integrating molecular, microbiological, and modeling approaches.