

Seth M. Bushinsky

Current position: Assistant Professor, Department of Oceanography
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Education

Ph.D., Oceanography, October 2015, University of Washington, Seattle, WA
M.S., Oceanography, August 2011, University of Washington, Seattle, WA
B.S., Biological Sciences with honors in Marine Biology, June 2006, Stanford University, Stanford, CA

Professional History

Assistant Professor, Department of Oceanography, Marine Geology and Geochemistry Division, *University of Hawai'i-Mānoa*, HI. 2019-present.
Associate Research Scholar, Program in Atmospheric and Oceanic Sciences, *Princeton University*, NJ. 2018-2019.
Postdoctoral Research Associate with Dr. Jorge Sarmiento, Program in Atmospheric and Oceanic Sciences, *Princeton University*, NJ. 2015-2018.
Research Technician for Dr. Francisco Chavez, Biological Oceanography Group. *Monterey Bay Aquarium Res. Institute*, Moss Landing, CA. 2006-2008.

Research Interests

- Biogeochemical cycles, with a focus on the processes that control the transfer of oxygen and carbon across the air-sea interface.
- Interpretation of data from autonomous vehicles to understand the biological carbon cycle.
- Air-sea gas exchange.
- In situ calibration of oxygen sensors.
- Southern Ocean processes controlling air-sea oxygen and carbon fluxes and nutrient export.
- The role of mode water formation in driving air-sea fluxes of carbon, oxygen, and subsequent transport of biogeochemical tracers into the ocean interior.

Research

‡Student advisee.

Manuscripts in review:

1. Ito, T. Hernan E. Garcia, Zhankun Wang, Shoshiro Minobe, Matthew C. Long, Just Cebrian, James Reagan, Tim Boyer, Christopher Paver, Courtney Bouchard, Yohei Takano, **Seth Bushinsky**, Ahron Cervania, Curtis A. Deutsch. Underestimation of global O₂ loss in optimally interpolated historical ocean observations. In review at *Biogeosciences Discussions*.

Publications:

26. Hauck, J, L Gregor, Cara Nissen, Lavinia Patara, Mark Hague, N. Precious Mongwe, **Seth Bushinsky**, Scott C. Doney, Nicolas Gruber, Corinne Le Quéré, Manfredi Manizza, Matthew Mazloff, Pedro M. S. Monteiro, Jens Terhaar. (2023). The Southern Ocean carbon cycle 1985-2018: Mean, seasonal cycle, trends and storage. Accepted at *Global Biogeochemical Cycles*.
25. Sauv , J., A. Gray, C. J. Prend, **S. M. Bushinsky**, S. Riser. Carbon outgassing in the Antarctic Circumpolar Current is supported by Ekman transport from the sea ice zone in an observation-based seasonal mixed-layer budget. (2023). Accepted at *Journal of Geophysical Research – Oceans*. Pre-print available at:
<https://doi.org/10.22541/essoar.168614447.70190887/v1>
24. Sarmiento, J. L., Johnson, K. S., Arteaga, L. A., **Bushinsky, S. M.**, Cullen, H. M., Gray, A. R., et al. (2023). The Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) project: A review. In Press at *Progress in Oceanography*, 103130. <https://doi.org/10.1016/j.pocean.2023.103130>
23. †**McClish, S., & Bushinsky, S.** (2023). Majority of Southern Ocean seasonal sea ice bloom net community production precedes total ice retreat. In press at *Geophysical Research Letters*. [https://doi.org/Pre-print available: 10.1002/essoar.10512979.2](https://doi.org/Pre-print%20available:10.1002/essoar.10512979.2)
22. Rodgers, K. B., Schwinger, J., Fassbender, A. J., Landsch tzer, P., Yamaguchi, R., Frenzel, H., et al. (2023). Seasonal Variability of the Surface Ocean Carbon Cycle: A Synthesis. *Global Biogeochemical Cycles*, 37(9), e2023GB007798.
<https://doi.org/10.1029/2023GB007798>
21. Huang, Y., Fassbender, A. J., & **Bushinsky, S. M.** (2023). Biogenic carbon pool production maintains the Southern Ocean carbon sink. *Proceedings of the National Academy of Sciences*, 120(18). <https://doi.org/10.1073/pnas.2217909120>
20. Hauck, J., Nissen, C., Landsch tzer, P., R denbeck, C., **Bushinsky, S.**, & Olsen, A. (2023). Sparse observations induce large biases in estimates of the global ocean CO₂ sink: an ocean model subsampling experiment. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 381(2249), 20220063.
<https://doi.org/10.1098/rsta.2022.0063>
19. **Bushinsky, S. M.**, & Cerove ki, I. (2023). Subantarctic Mode Water Biogeochemical Formation Properties and Interannual Variability. *AGU Advances*, 4(2), e2022AV000722. <https://doi.org/10.1029/2022AV000722>
§**Eos Research Spotlight.**
18. Tamsitt, V., **S. Bushinsky**, Z. Li, M. du Plessis, A. Foppert, S. Gille, S. Rintoul, E. Shadwick, A. Silvano, A. Sutton, S. Swart, B. Tilbrook, and N. L. Williams, (2021). Antarctica and the Southern Ocean [in “State of the Climate in 2020”]. *Bull. Amer. Meteor. Soc.*, 102 (8), S345–S349, doi:10.1175/BAMS-D-21-0081.1.
17. Johnson, K.S., M.F. Bif, **S.M. Bushinsky**, A.J. Fassbender, and Y. Takeshita. Biogeochemical Argo [in “State of the Climate in 2019”] (2020). *Bull. Amer. Meteor. Soc.*, 101 (8), S39–S41, doi: 10.1175/BAMS-D-20-0105.1.
16. **Bushinsky, S. M.**, Landsch tzer, P., R denbeck, C., Gray, A. R., Baker, D., Mazloff, M. R., et al. (2019). Reassessing Southern Ocean Air-Sea CO₂ Flux Estimates With the Addition of Biogeochemical Float Observations. *Global Biogeochemical Cycles*,

- 33(11), 1370–1388. <https://doi.org/10.1029/2019GB006176>
†**Editor’s Highlight.** §**Eos Research Spotlight.** ***Recognized as one of the most read papers in GBC 2018-2019.**
15. Arteaga, L. A., Pahlow, M., **Bushinsky, S. M.**, & Sarmiento, J. L. (2019). Nutrient Controls on Export Production in the Southern Ocean. *Global Biogeochemical Cycles*, 33(8), 942–956. <https://doi.org/10.1029/2019GB006236>
 14. **Bushinsky, S. M.**, Takeshita, Y., & Williams, N. L. (2019). Observing Changes in Ocean Carbonate Chemistry: Our Autonomous Future. *Current Climate Change Reports*, 5(3), 207–220. <https://doi.org/10.1007/s40641-019-00129-8>
 13. **Bushinsky, S. M.**, & Emerson, S. R. (2018). Biological and physical controls on the oxygen cycle in the Kuroshio Extension from an array of profiling floats. *Deep Sea Research Part I: Oceanographic Research Papers*. <https://doi.org/10.1016/j.dsr.2018.09.005>
 12. Gray, A. R., Johnson, K. S., **Bushinsky, S. M.**, Riser, S. C., Russell, J. L., Talley, L. D., et al. (2018). Autonomous Biogeochemical Floats Detect Significant Carbon Dioxide Outgassing in the High-Latitude Southern Ocean. *Geophysical Research Letters*, 45(17), 9049–9057. <https://doi.org/10.1029/2018GL078013>
***Recognized as one of the most read papers in GRL 2018-2019.**
 11. **Bushinsky, S. M.**, Gray, A. R., Johnson, K. S., & Sarmiento, J. L. (2017). Oxygen in the Southern Ocean From Argo Floats: Determination of Processes Driving Air-Sea Fluxes. *Journal of Geophysical Research: Oceans*, 122(11), 8661–8682. <https://doi.org/10.1002/2017JC012923>
†**Editor’s Highlight.**
 10. Yang, B., Emerson, S. R., & **Bushinsky, S. M.** (2017). Annual net community production in the subtropical Pacific Ocean from in situ oxygen measurements on profiling floats. *Global Biogeochemical Cycles*, 31(4), 728–744. <https://doi.org/10.1002/2016GB005545>
 9. Newsom, E. R., Fassbender, A. J., Maloney, A. E., & **Bushinsky, S. M.** (2016). Increasing the usability of climate science in political decision-making. *Elementa: Science of the Anthropocene*, 4, 000127. <https://doi.org/10.12952/journal.elementa.000127>
 8. Emerson, S., & **Bushinsky, S.** (2016). The role of bubbles during air-sea gas exchange. *Journal of Geophysical Research: Oceans*, 121(6), 4360–4376. <https://doi.org/10.1002/2016JC011744>
 7. **Bushinsky, S. M.**, Emerson, S. R., Riser, S. C., & Swift, D. D. (2016). Accurate oxygen measurements on modified Argo floats using in situ air calibrations. *Limnology and Oceanography: Methods*, 14(8), 491–505. <https://doi.org/10.1002/lom3.10107>
†**Editor’s Highlight.**
 6. **Bushinsky, S. M.**, & Emerson, S. (2015). Marine biological production from in situ oxygen measurements on a profiling float in the subarctic Pacific Ocean. *Global Biogeochemical Cycles*, 29(12), 2050–2060. <https://doi.org/10.1002/2015GB005251>
***Cover Article**
 5. Emerson, S., & **Bushinsky, S.** (2014). Oxygen Concentrations and Biological Fluxes in the Open Ocean. *Oceanography*, 27(1), 168–171. <https://doi.org/10.5670/oceanog.2014.20>

4. **Bushinsky, S. M.**, & Emerson, S. (2013). A method for in-situ calibration of Aanderaa oxygen sensors on surface moorings. *Marine Chemistry*, 155, 22–28.
<https://doi.org/10.1016/j.marchem.2013.05.001>
3. Howard, E., Emerson, S., **Bushinsky, S.**, & Stump, C. (2010). The role of net community production in air-sea carbon fluxes at the North Pacific subarctic-subtropical boundary region. *Limnology and Oceanography*, 55(6), 2585–2596.
<https://doi.org/10.4319/lo.2010.55.6.2585>
2. Arrigo, K. R., van Dijken, G. L., & **Bushinsky, S.** (2008). Primary production in the Southern Ocean, 1997-2006. *Journal of Geophysical Research*, 113(C08004), doi:10.1029/2007JC004551. <https://doi.org/10.1029/2007JC004551>
1. Micheli, F., Shelton, A. O., **Bushinsky, S. M.**, Chiu, A. L., Haupt, A. J., Heiman, K. W., et al. (2008). Persistence of depleted abalones in marine reserves of central California. *Biological Conservation*, 141(4), 1078–1090.
<https://doi.org/10.1016/j.biocon.2008.01.014>

Technical Reports / White Papers:

2. **Bushinsky, SM**, RC Hamme, DP Nicholson, KS Johnson (2017). Oxygen measurements from autonomous vehicles: applications and challenges. *Autonomous and Lagrangian Platforms and Sensors II*.
1. Wanninkhof, R, K Johnson, N Williams, J Sarmiento, S Riser, E Briggs, **S Bushinsky**, B Carter, A Dickson, R Feely, A Gray, L Juranek, R Key, L Talley, J Russel, A Verdy (2016). An evaluation of pH and NO₃ sensor data from SOCCOM floats and their utilization to develop ocean inorganic carbon products. *Southern Ocean Carbon and Climate Observations and Modeling Carbon Working Group*.

Datasets:

1. Landschützer, Peter; **Bushinsky, Seth**; Gray, Alison R. (2019). A combined globally mapped CO₂ flux estimate based on the Surface Ocean CO₂ Atlas Database (SOCAT) and Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) biogeochemistry floats from 1982 to 2017 (NCEI Accession 0191304). Version 2.2. NOAA National Centers for Environmental Information. Dataset. doi:10.25921/9hsn-xq82 [2019-07-17].

Research Support

Current

National Aeronautics and Space Administration: Carbon Monitoring System, *Advancing satellite-constrained modeled air-sea CO₂ fluxes with a focus on the strength of the Southern Ocean carbon sink*. January 2023 – December 2025. **\$106,808 to UHM**. Lead PI: L. Arteaga (NASA/ University of Maryland Baltimore County), **Co-I/Institutional PI S. Bushinsky** (University of Hawai‘i at Mānoa), Co-I C. Rousseaux (NASA Goddard), Collaborator L. Ott (NASA Goddard).

National Science Foundation: Chemical Oceanography, Physical Oceanography, and EPSCOR, *Collaborative Research: Physical and biological controls on ocean carbon and oxygen uptake in the Western North Pacific*. June 2021 – May 2024. **\$874,423 to UHM. Lead PI: S. Bushinsky** (University of Hawai‘i at Mānoa), Co-PIs M. Manizza, I. Cerovecki (Scripps Institution of Oceanography).

National Aeronautics and Space Administration: Carbon Cycle Science, *Quantifying the role of mode and intermediate waters in Southern Ocean carbon fluxes through the use of profiling floats, satellite observations, and a state estimate*. July 2021 – June 2024. **\$810,461 to UHM. Lead PI S. Bushinsky** (University of Hawai‘i Mānoa). Co-PI: I. Cerovecki (Scripps Institution of Oceanography)

National Oceanographic and Atmospheric Administration, *Biogeochemical Argo synthesis products of oxygen, nitrate, and pH for increased community utilization of autonomous profiling observations*. September 2021 – August 2024. (**\$389,905 to UHM**: \$273,249 in initial award plus \$116,656 after re-budgeting between institutions). **Lead PI S. Bushinsky** (University of Hawai‘i Mānoa), Co-PIs: N. Williams (University of South Florida), A. Fassbender (NOAA-PMEL).

National Aeronautics and Space Administration, *Characterizing the impact of seasonal sea ice on phytoplankton blooms and net community production with integrated satellite and biogeochemical profiling float observations*, September 2021 – August 2024. **\$135,000 to UHM. PI: S. Bushinsky**. FINESST Graduate Student Fellowship for Future Investigator Shannon McClish (advisee).

Past funded

National Aeronautics and Space Administration, *Determination of the Relationship between primary Production and Net Community Production in Southern Ocean through the use of profiling floats, satellite data, and ecosystem models*, March 2017 – March 2020 (subaward period July 2019 – March 2020), **\$137,223 to UHM**, PIs: J. Sarmiento (Princeton University), **S. Bushinsky** (University of Hawai‘i Mānoa)

Teaching

Courses taught

OCN 623, Chemical Oceanography: 2020-present

OCN 201/201L, Science of the Sea: 2020 - present

Advising

Current advisees

Postdoctoral scholars

Daniela König: April 2023-present

Mathilde Jutras: September 2023-present.

Graduate students (UHM OCN, unless otherwise noted):

Jomphol Lamoonkit (ORE): 2023-present, MS Committee member
Michaela Setzer: 2023-present, PhD Committee member
Joelle Mattos: 2023-present, Advisory Committee member
Charles Addey: 2022-present, **Chair**
Zachary Nachod: 2022-present, **Chair**
Ryo Dobashi: 2021-present, Advisory Committee, PhD Committee member
Shannon McClish: 2020-present, **Chair**
Simin Kheradmand (University of Victoria, BC, Canada): 2023-present, PhD Committee member

Past advisees

Graduate students

Alexus Cazares: 2020-2023, Advisory Committee member, Comprehensive Exam Committee member
Blake Stoner-Osborne: 2023, Comprehensive Exam Committee member
Gordon Walker: 2023, Comprehensive Exam Committee member
James Ash, MS: 2021-2023. **MS Committee Co-Chair**
Jacob Gunnarson: 2023, Comprehensive Exam Committee member
Noah Howins: 2022-2023, MS Committee member
Connor Shea: 2022, Comprehensive Exam Committee member
Kacy Kim (Hawai'i Pacific University). 2022, Currently on leave of absence. MS Committee member
Eleanor Bates: 2022, Comprehensive Exam Committee member
Joani Villiunas: 2021, Advisory Committee member

Undergraduate students

Kamryn Shimizu: 2022
Anthony Barro: (Thesis advisor, Defended Fall 2020)

Service

Departmental

Uehiro Faculty Search Committee member, September 2022 – August 2023.

MGG Faculty Search Committee member, July 2022 – January 2023.

TA Assignment Committee for Fall 2022.

Marine Geosciences and Geology Division graduate student selection committee, Fall 2022, Fall 2021 entrances.

SOEST Speed Networking faculty participant, August 2021.

Kahuliau / Interim Diversity Equality and Inclusion Committee member, February 2021 – present.

- Fall 2022 SEED IDEAs application for DEI speaker honoraria
- Coordination of OCN Seminar DEIJ speakers

Unlearning Racism in Geosciences (URGE) Pod Leader, January 2021 – May 2022.

Marine Geosciences and Geology Division Admissions Guideline Creation Committee, member, February 2021 – May 2021.

Provided the “Graduate Student Agreement” I developed for my group to the students drafting the new Oceanography “Student-Advisor Contract”. Gave feedback on an early draft of the developing document, June 2020 – September 2021

Teaching Evaluation Committee, member, May 2020 – present.

Mega-search (four position) Committee, member January – March 2020.

Search advocate training, February 2020.

Research Presentations to OCN 100: Global Environmental Science Seminar, 2020, 2021

Deep Sea Ecologist Search Committee, member. December 2019

Spring 2020 Ocean 780 Seminar Coordinator

GES undergraduate symposium evaluator: Kealohi Sabate, December 2019; Sara Bower, May 2022.

Presentation to Mauka to Makai Bridge summer course entitled “Understanding ocean biogeochemistry using robots.” July 2019.

University

ORE Faculty Search Committee member, Sept. 2023 – present.

National

Ocean Sciences Meeting 2022, Co-Chair of *HL06 Advances in understanding the circulation and carbon cycle of the Southern Ocean*.

Ocean Carbon and Biogeochemistry Scientific Steering Committee early career member, 2020-2021; regular member, 2022.

Journal peer reviewer for:

<i>Biogeosciences (x2)</i>	<i>Limnology and Oceanography: Methods (x5)</i>
<i>Deep Sea Research Part I</i>	<i>Methods in Oceanography</i>
<i>Frontiers in Marine Science</i>	<i>Nature Communications</i>
<i>Geophysical Research Letters (x6)</i>	<i>Nature Geosciences</i>
<i>Geosciences</i>	<i>Nature Reviews Earth and Environment</i>
<i>Global Biogeochemical Cycles (x7)</i>	<i>Ocean Science</i>
<i>Journal of Atmospheric and Oceanic Technology</i>	<i>Ocean Science Discussions</i>
<i>Journal of Geophysical Research (JGR): Atmosphere</i>	<i>Polar Research</i>
<i>JGR: Oceans (x6)</i>	<i>Phil. Trans. Royal Soc. A</i>
<i>Journal of Sea Research</i>	<i>Progress in Oceanography Science</i>

Proposal reviewer: National Science Foundation (Chemical Oceanography (x6), Physical Oceanography (x2), Ocean technology (x3), Polar Programs, CAREER), National Ocean Partnership Program, National Oceanic and Atmospheric Administration (Climate Observations and Monitoring, Ocean Acidification Program (x2)), Dutch Research Council.

External reviewer for promotion: Scripps Institution of Oceanography

Adviser for ocean carbon cycle portion of National Public Radio news story: *Your Next Car May Be Built With Ocean Rocks. Scientists Can't Agree If That's Good*. Contacted by Neela Banerjee, Supervising Climate Editor. Sept. 2021

Media/News

NOAA Research: *One of The Planet's Most Important Carbon Sinks is Revealing its Secrets*. April 2023. <https://research.noaa.gov/2023/04/26/one-of-the-planets-most-important-carbon-sinks-is-revealing-its-secrets/>

Eos: A deeper dive into wintry, carbon-absorbing Antarctic waters, <https://doi.org/10.1029/2023EO230096>. Published on 8 March 2023.

NOAA Climate Program Office notice of funding. October 2021. <https://cpo.noaa.gov/Funding-Opportunities/FY2021-Recipients> .

UH News: \$2.7M for ocean floats, satellites to give UH scientists new ocean, climate insights. October 2021. <https://www.hawaii.edu/news/2021/10/15/ocean-floats-satellites-grants/>

Eos: Ship-Based Measurements Overestimate Southern Ocean Carbon Sink. November 2019.
<https://eos.org/research-spotlights/ship-based-measurements-overestimate-southern-ocean-carbon-sink>

OCB Science Highlights: A new era of observing the ocean carbonate system. June 2019.
<https://www.us-ocb.org/a-new-era-of-observing-the-ocean-carbonate-system/>

Science News: The Southern Ocean may be less of a carbon sink than we thought. June 2019.
<https://www.sciencenews.org/article/southern-ocean-antarctica-absorbs-less-carbon-expected?tgt=nr>

Chemical & Engineering News: How robots are revolutionizing chemical oceanography. May 2019. <https://cen.acs.org/environment/water/Podcast-robots-revolutionizing-chemical-oceanography/97/i21>

Nature News: Massive ocean carbon sink spotted burping CO₂ on the sly. December 2018.
<https://www-nature-com.eres.library.manoa.hawaii.edu/articles/d41586-018-07784-1>