

# Matthew C. Long

## Curriculum Vitae

### Contact

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### 1 Educational information

2010	Ph.D., Oceanography, Stanford University, Stanford, CA
2000	M.S., Environmental Engineering, Tufts University, Medford, MA
1998	B.S., Environmental Engineering, Tufts University, Medford, MA

### 2 Professional Experience

2014–present	Scientist I, II, III(tenure-equivalent), National Center for Atmospheric Research, Climate and Global Dynamics Laboratory, Oceanography Section
2012–2014	Project Scientist I, National Center for Atmospheric Research, Climate and Global Dynamics Division, Oceanography Section
2010–2012	Postdoctoral Fellow, National Center for Atmospheric Research, Advanced Study Program, Climate and Global Dynamics Division
2005–2010	Research Assistant, Stanford University Developed computer-automated instruments to measure inorganic carbon, alkalinity and pH in seawater. Operated and maintained Finnigan MAT 252 isotope ratio mass spectrometer with Kiel carbonate device and Finnigan MAT Delta+ with Carlo Erba elemental analyzer.
2004–2009	Teaching Assistant, Stanford University Courses: Introduction to Geology, Stanford at SEA, Coastal Oceanography, Antarctic Marine Geology and Geophysics, Advanced Oceanography, Oceanic Fluid Dynamics. Led Engineers for a Sustainable World course to design an energy-efficient secondary school in Iringa, Tanzania.
2003–2004	Water Resources Engineer, Camp Dresser & McKee Inc., Cambridge, MA Developed hydrologic, hydraulic, and water quality models for management and system optimization of sewer networks and urban rivers.
2003	Field and Laboratory Technician, Desert Research Institute, Reno, NV Species diversity surveys of freshwater springs in Mohave National Preserve. Surface and ground water quality sampling and analysis on the Truckee River.

- 2000–2002     High School Physics & Geography Teacher, US Peace Corps, Tanzania, Ashira Girls Secondary School, Marangu, Tanzania US Peace Corps, Tanzania  
 Ashira Girls Secondary School, Marangu, Tanzania  
 Taught topics in physical science, weather and climate, & economic development. Wrote a computer manual and taught computer literacy. Led a student (16 girls) climb of Mt. Kilimanjaro (5,895 m); taught teachers to teach an HIV/AIDS curriculum; co-organized a nationwide review of the national science and math curriculum.
- 1998–2000     Teaching Assistant, Tufts University, Dept of Civil and Env. Engineering Managed environmental engineering teaching laboratory. Taught analytical methods, statistical experimental design, data analysis and interpretation.
- 1999            Environmental Analyst, MA Dept of Public Health,  
 Bureau of Env. Health Assessment, Epidemiology Unit  
 Developed a GIS-based environmental exposure-assessment protocol examining the effect of air pollution on the prevalence and distribution of pediatric asthma.

### 3 Scientific/Technical Accomplishments

Ocean biogeochemistry and marine ecosystems in the Earth system. I lead the development of Marine Biogeochemical Library (MARBL), which is the ocean biogeochemistry component used in the Community Earth System Model (CESM). In addition to promoting robust scientific representations of the ocean carbon cycle and the biological pump, we designed MARBL to be flexible with respect to coupling with multiple ocean models and invoking ecosystem representations spanning a range in complexity. I have engaged outside collaborators to contribute to MARBL and continue to build community involvement in MARBL development. We have also recently begun implementation of the Fisheries Size and Functional Type model (FEISTY) in CESM, aiming to establish a basis for prediction of climate-driven variation in fish.

Aircraft observations to constrain the carbon cycle. I collaborate with Britton Stephens (NCAR) to develop the use of aircraft observations as a constraint on the global carbon cycle. I co-led the O<sub>2</sub>/N<sub>2</sub> Ratio and CO<sub>2</sub> Airborne Southern Ocean Study (ORCAS), which performed intensive airborne surveys over the Southern Ocean aboard the NSF/NCAR Gulfstream V aircraft during Jan–Feb 2016. Following on the success of ORCAS, we obtained funding to support the Southern Ocean Carbon Gas Observatory (SCARGO), which will collect atmospheric CO<sub>2</sub> on the LC-130 aircraft servicing McMurdo Station and South Pole Observatory. In addition to several other publications, I am lead author of a significant paper using data from ORCAS and other aircraft campaigns to constrain Southern Ocean CO<sub>2</sub> fluxes.

Earth System Data Science. Effective synthesis and analysis of large datasets is a rate-limiting step to advancing Earth system science. I have been inspired by recent developments in open-source scientific software, notably those identified by the Pangeo community, that provide technical solutions to Big Data geoscience problems and paradigms for large-scale collaboration. I have been leading an effort to establish a “community of practice” at NCAR/UCAR aiming to improve collaboration on analytics, explore the margins of what’s possible with data, and more effectively grow our capacity in machine learning and artificial intelligence.

## 4 Community Service

### Mentoring

#### Postdoctoral researchers supervised

- Jesse Vance (2022–)
- N. Precious Mongwe (2018–2021; currently a Researcher at Council for Scientific and Industrial Research (CSIR), Cape Town, South Africa)
- Kristen Krumhardt (2018–2020; currently an Associate Scientist at NCAR)
- Magdalena Carranza (ASP Fellow, 2018–2020; currently at MBARI)
- Jessica Luo (2016–2019; currently a Research Oceanographer at GFDL)
- Daniel Whitt (2017; currently Research Scientist at NASA, Ames)
- Cheryl Harrison (2015–2017; currently Assistant Professor, Univ of Texas)

#### Ph.D. Dissertation committees

- Zephyr Sylvester (PhD expected 2024, CU Boulder, Advisor: C. Brooks): Title TBD.
- Sebastian Cantarero (PhD 2022, CU Boulder, Advisor: J. Sepulveda): Microbial Communities and the Biogeochemistry of the Eastern Tropical South Pacific; a Lipidomic Approach in Natural Environments and Mesocosm Experiments.
- Riley Brady (PhD 2020, CU Boulder, Advisor: N. Lovenduski): The Variable Circulation and Carbonate Chemistry of Ocean Upwelling Systems.
- Sean Ridge (PhD 2020, Columbia Univ, Advisor: Galen McKinley): Effects of Ocean Circulation on Ocean Anthropogenic Carbon Uptake.
- F. Garrett Boudinot (PhD 2020, CU Boulder, Advisor: J. Sepulveda): Changes in marine ecology and nitrogen cycling during during a Cretaceous Ocean Anoxic Event .
- Tyler Rohr (PhD 2019, MIT/WHOI, Advisor: Scott Doney): Untangling the controls on Southern Ocean phytoplankton ecosystem dynamics.
- Yassir Eddebbar (PhD 2018, Scripps, Advisor: Ralph Keeling): Climate Modulations of Air-Sea Oxygen, Carbon, and Heat Exchange.

#### Graduate student visitors hosted at NCAR

- Zephyr Sylvester (CU Boulder, Advisor: Cassandra Brooks, Summer 2019): Informed management of Southern Ocean Krill Fisheries.
- Mariela Brooks (Scripps, Advisor: Ralph Keeling, Apr 2018): Analysis of oceanic  $^{13}\text{C}$  in CESM and comparison to ocean time series.
- Sean Ridge (Univ. Wisconsin, Advisor: Galen McKinley, May–Aug 2017): Analysis of oceanic carbon-climate feedbacks in the Community Earth System Model (CESM).
- Elizabeth Asher (Univ. British Columbia, Advisor: Philippe Tortell, Sept 2013–Apr 2014): worked on modeling oxidation pathways of dimethyl sulfide in the atmospheric chemistry component of the Community Earth System Model (CESM).

- Simon Yang (ETH, Advisor: Nicolas Gruber, Jun–Jul 2013): added nitrogen isotopes to CESM marine biogeochemistry model, investigation of climate and anthropogenic controls on N cycling.
- Rebecca Asch (Scripps, Advisor: David Checkley, Mar 2013): Phenology of phytoplankton blooms in CESM.

#### Professional activities

2023	Co-lead author, Chapter on Modeling Ocean Alkalinity Enhancement (OAE) in the OAE Best Practices Guide (in progress, target publish date: Fall 2023).
2022–	Expert Advisor Frontier: An advance market commitment to accelerate carbon removal
2022–	Co-Chair: Community Earth System Model, Biogeochemistry Working Group
2022	Co-organizer: Ocean Carbon & Biogeochemistry Workshop: Marine Carbon Dioxide Removal: Essential Science and Problem Solving for Measurement, Reporting, and Verification
2022–	Expert Advisor: Ocean Visions LaunchPad, supporting selected competitors for the \$100M XPRIZE in Carbon Removal
2022–	Working Group #5 Member: UN Decade of Ocean Science for Sustainable Development programme “Ocean Acidification Research for Sustainability” (OARS)
2020–2022	Co-Chair: NCAR Scientist Assembly, Executive Committee
2021–2022	Member: Ocean Visions Expert Working group – Designing a Framework for Responsible Research: Sinking Marine Biomass for CO <sub>2</sub> Removal
2020–2022	Member: NOAA Marine Ecosystem Task Force
2019	Lead organizer: CLIVAR/OCB CMIP6 Hackathon ( <a href="https://cmip6hack.github.io">cmip6hack.github.io</a> )
2019	Member: NCAR Strategic Plan Steering Committee
2018–2020	Member: Ocean Carbon & Biogeochemistry (OCB) Scientific Steering Committee
2018	Member: NOAA Integrated Ecosystem Assessment ( <a href="https://www.noaa.gov/iea">www.noaa.gov/iea</a> ) Climate Change Working Group
2015	Member: Steering group and writing team for the NASA Ocean Biology and Biogeochemistry Advanced Science Plan and pre-Decadal Survey Report
2012–2015	Member: CLIVAR/OCB Working Group, Oceanic carbon uptake in CMIP5 models
2013	Lead organizer: 2013 NCAR Advanced Study Program Graduate Student Colloquium: Carbon-climate connections in the Earth System <a href="https://www.cgd.ucar.edu/events/20130729/">https://www.cgd.ucar.edu/events/20130729/</a>
2004–present	Member, American Geophysical Union

## 5 Honors and Awards

2022–	Associate Editor, Journal of Advances in Modeling Earth Systems
2010–2012	NCAR Advanced Study Program Postdoctoral Fellowship
2006	Antarctic Service Medal

## 6 Proposals and Grants

2021–2024	NASA, 20-ECOF20-0020, Hot spots in the ice: revealing the importance of polynyas for sustaining present and future Antarctic marine ecosystems, A. K. DuVivier (NCAR), C. M. Brooks (CU/Boulder), S. Jenouvrier (WHOI), S. Labrousse (IPSL), M. C. Long (NCAR) and M.M. Holland (NCAR).
2021-2024	NSF-EarthCube, Collaborative Research: EarthCube Data Capabilities: Project Pythia: A Community Learning Resource for Geoscientists, J. Clyne (NCAR), R. May (Unidata), K. Paul (NCAR), M. C. Long (NCAR), B. E. J. Rose (U Albany), K. Tyle (U Albany).
2021–2024	NASA, Interdisciplinary Research in Earth Science, Antarctic marine predators in a dynamic climate, S. Jenouvrier (WHOI), M. M. Holland (NCAR), M. C. Long (NCAR), H. Lynch (Stony Brook), M. LaRue (University of Canterbury).
2020–2023	NOAA-OAR-CPO, Incorporating fish into Earth system predictions, M. C. Long (NCAR), C Petrik (TAMU), S. Siedlecki (UCONN), G. Danabasoglu (NCAR), C. Stock (GFDL).
2020–2023	NOAA-OAR-CPO, The predictability of oxygen and its metabolic consequences for fisheries on decadal time scales, S. Siedlecki (UCONN), M. C. Long (NCAR), C Petrik (TAMU)
2020–2023	NOAA-OAR-CPO, Towards the prediction of fisheries on seasonal to multi-annual time scales, C Petrik (TAMU), S. Siedlecki (UCONN), M. C. Long (NCAR).
2020–2023	NSF OCE-1948728, Collaborative Research: Forced drivers of trends in ocean biogeochemistry: Volcanos and atmospheric carbon dioxide, G. McKinley (Columbia), N. Lovenduski (CU/Boulder), M. C. Long (NCAR).
2020–2023	NSF OCE-1948718, Collaborative Research: Mesoscale Drivers of Oxygen in the Tropical Pacific, Y. Eddebbbar (Scripps), A. Subramanian (CU/Boulder), M. C. Long (NCAR), D. Whitt (NCAR).
2019–2022	NSF OPP-1839218, Collaborative Research: Southern Ocean Carbon Gas Observatory (SCARGO), B. B. Stephens (NCAR/EOL), M. C. Long (NCAR/CGD), K. McKain (CU/CIRES).
2017–2020	NSF OCE-1737158, Collaborative Research: Combining Theory and Observations to Constrain Global Ocean Deoxygenation, T. Ito (GT), C. Deutsch (UW), M. C. Long (NCAR).

- 2017-2020 NSF OCE-1735846, Collaborative Research: Biogeochemical and physical conditioning of Subantarctic Mode Water in the Southern Ocean, W. Balch (Bigelow Laboratory), N. Bates (BIOS) P. Morton (Florida State), D. McGillicuddy (WHOI), M. C. Long (NCAR).
- 2017-2020 NSF OCE-1658541, Collaborative Research: The impact of climate change on the physics and biology of the ocean on scales down to the submesoscale, K. Richards (UH), F.O. Bryan (NCAR), M. C. Long (NCAR), A. Thompson (Caltech).
- 2015-2017 NSF PLR-1501993, O<sub>2</sub>/N<sub>2</sub> Ratio and CO<sub>2</sub> Airborne Southern Ocean (ORCAS) Study, B. Stephens (NCAR) and M. C. Long (NCAR).
- 2014-2017 DOE/SciDAC, DE-SC0012603, A modular biogeochemical modeling suite for next-generation ocean models, M. C. Long (NCAR), K. Lindsay (NCAR), M. Vertenstein (NCAR), M. Maltrud (LANL), and T. Ringler (LANL).
- 2014-2017 DOE/SciDAC, SC0012605, Southern Ocean Uptake in the MPAS-Ocean Model, W. G. Large (NCAR), M. C. Long (NCAR), G. Danabasoglu (NCAR), T. Ringler (LANL), J. Edwards (NCAR), M. Levy (NCAR).
- 2014-2017 NASA 13-TERAQ13-0089, Multi-scale biophysical dynamics governing ocean phytoplankton community structure, S. C. Doney (WHOI), D. Glover (WHOI), M. Kavanaugh (WHOI), M. C. Long (NCAR).
- 2014-2015 NSF Lower Atmospheric Observing Facilities, O<sub>2</sub>/N<sub>2</sub> Ratio and CO<sub>2</sub> Airborne Southern Ocean (ORCAS) Study, B. Stephens (NCAR) and M. C. Long (NCAR).
- 2013-2014 USDA-NIFA, GRANT11362158, Key uncertainties in the global carbon cycle: Perspectives across terrestrial and ocean ecosystems, M. C. Long (NCAR), N. M. Levine (USC), R. Q. Thomas (VT), G. A. McKinley (U. Wisc.).

## 7 Publication List

### Thesis

1. Long, M. C. (2010), Upper ocean physical and ecological dynamics in the Ross Sea, Antarctica, Ph.D. thesis, Stanford University.
2. Long, M. C. (1998), Monitoring and Modeling of Road Salt in Upper Mystic Lake, M.S. thesis, Tufts University.

### Refereed Journal Articles

(<sup>†</sup>postdoc; \*student-advisee)

1. Arrigo, K. R., G. van Dijken, and M. C. Long (2008), Coastal Southern Ocean: A strong anthropogenic CO<sub>2</sub> sink, *Geophysical Research Letters*, 35, L21602, doi:10.1029/2008GL035624.

2. Rose, J. M., Y. Feng, G. R. DiTullio, R. B. Dunbar, C. E. Hare, P. A. Lee, M. Lohan, M. C. Long, W. O. Smith Jr., B. Sohst, S. Tozzi, Y. Zhang, and D. A. Hutchins (2009), Synergistic effects of iron and temperature on Antarctic plankton assemblages, *Biogeosciences*, 6(12), 3131–3147, doi:10.5194/bg-6-3131-2009.
3. Tortell, P. D., and M. C. Long (2009), Spatial and temporal variability of biogenic gases during the Southern Ocean spring bloom, *Geophysical Research Letters*, 36, L01603, doi:10.1029/2008GL035819.
4. Feng, Y., C. Hare, J. Rose, S. Handy, G. DiTullio, P. Lee, W. S. Jr., J. Peloquin, S. Tozzi, J. Sun, Y. Zhang, R. Dunbar, M. C. Long, B. Sohst, M. Lohan, and D. Hutchins (2010), Interactive effects of iron, irradiance and CO<sub>2</sub> on Ross Sea phytoplankton, *Deep Sea Research, Part I*, 57, 368–383, doi:10.1016/j.dsr.2009.10.013.
5. Munro, D. R., R. B. Dunbar, D. A. Mucciarone, K. R. Arrigo, and M. C. Long (2010), Stable isotope composition of dissolved inorganic carbon and particulate organic carbon in sea ice from the Ross Sea, Antarctica, *Journal of Geophysical Research*, 115(C9), C09005, doi:10.1029/2009JC005661.
6. Berg, G. M., M. M. Mills, M. C. Long, R. Bellerby, V. Strass, N. Savoye, R. Röttgers, P. L. Croot, A. Webb, and K. R. Arrigo (2011), Variation in particulate C and N isotope composition following iron fertilization in two successive phytoplankton communities in the Southern Ocean, *Global Biogeochemical Cycles*, 25, GB3013, doi:10.1029/2010GB003824.
7. Long, M. C., R. B. Dunbar, P. D. Tortell, W. O. Smith, D. A. Mucciarone, and G. R. DiTullio (2011), Vertical structure, seasonal drawdown, and net community production in the Ross Sea, Antarctica, *Journal of Geophysical Research*, 116(C10029), doi:10.1029/2009JC005954.
8. Sedwick, P. N., C. M. Marsay, B. M. Sohst, A. M. Aguilar-Islas, M. C. Lohan, M. C. Long, K. R. Arrigo, R. B. Dunbar, M. A. Saito, W. O. Smith, and G. R. DiTullio (2011), Early season depletion of dissolved iron in the Ross Sea polynya: Implications for iron dynamics on the Antarctic continental shelf, *Journal of Geophysical Research*, 116(C15), C12019, doi:10.1029/2010JC006553.
9. Tortell, P. D., C. Guéguen, M. C. Long, C. D. Payne, P. Lee, and G. R. DiTullio (2011), Spatial variability and temporal dynamics of surface water pCO<sub>2</sub>,  $\Delta\text{O}_2/\text{Ar}$ , and dimethylsulfide in the Ross Sea, Antarctic, *Deep Sea Research, Part I*, 58(3), 241–259, doi:10.1016/j.dsr.2010.12.006.
10. Long, M. C., L. N. Thomas, and R. B. Dunbar (2012), Control of phytoplankton bloom inception in the Ross Sea, Antarctica, by Ekman restratification, *Global Biogeochemical Cycles*, 26(1), GB1006, doi:10.1029/2010GB003982.
11. Tortell, P. D., M. C. Long, C. D. Payne, A.-C. Alderkamp, P. Dutrieux, and K. R. Arrigo (2012), Spatial distribution of pCO<sub>2</sub>,  $\Delta\text{O}_2/\text{Ar}$  and dimethylsulfide (DMS) in polynya waters and the sea ice zone of the Amundsen Sea, Antarctica, *Deep Sea Research, Part II*, 71, 77–93, doi:10.1016/j.dsr2.2012.03.010.
12. Hurrell, J. W., M. M. Holland, P. R. Gent, S. Ghan, J. E. Kay, P. J. Kushner, J. F. Lamarque, W. G. Large, D. Lawrence, K. Lindsay, W. H. Lipscomb, M. C. Long, N. Mahowald, D. R.

- Marsh, R. B. Neale, P. Rasch, S. Vavrus, M. Vertenstein, D. Bader, W. D. Collins, J. J. Hack, J. Kiehl, and S. Marshall (2013), The Community Earth System Model: A Framework for Collaborative Research, *Bulletin of the American Meteorological Society*, doi:10.1175/BAMS-D-12-00121.1.
13. Long, M. C., K. Lindsay, S. Peacock, J. K. Moore, and S. C. Doney (2013), Twentieth-Century Oceanic Carbon Uptake and Storage in CESM1(BGC), *Journal of Climate*, 26(18), 6775–6800, doi:10.1175/JCLI-D-12-00184.1.
  14. Lovenduski, N. S., M. C. Long, P. R. Gent, and K. Lindsay (2013), Multi-decadal trends in the advection and mixing of natural carbon in the Southern Ocean, *Geophysical Research Letters*, 40(1), 139–142, doi:10.1029/2012GL054483.
  15. Moore, J. K., K. Lindsay, S. C. Doney, M. C. Long, and K. Misumi (2013), Marine ecosystem dynamics and biogeochemical cycling in the Community Earth System Model [CESM1(BGC)]: Comparison of the 1990s with the 2090s under the RCP4.5 and RCP8.5 scenarios, *Journal of Climate*, 26(23), 9291–9312, doi:10.1175/JCLI-D-12-00566.1.
  16. Smith, W. O., Jr., S. Tozzi, M. C. Long, P. N. Sedwick, J. A. Peloquin, R. B. Dunbar, D. A. Hutchins, Z. Kolber, and G. R. DiTullio (2013), Spatial and temporal variations in variable fluorescence in the Ross Sea (Antarctica): Oceanographic correlates and bloom dynamics, *Deep Sea Research*, 79, 141–155, doi:10.1016/j.dsr.2013.05.002.
  17. Doney, S. C., L. Bopp, and M. C. Long (2014), Historical and future trends in ocean climate and biogeochemistry, *Oceanography*, 27(1), 109–119, doi:10.5670/oceanog.2014.14.
  18. Downes, S. M., R. Farneti, P. Uotila, S. Marsland, S. M. Griffies, D. Bailey, E. Behrens, M. Bentsen, D. Bi, A. Biastoch, C. Böning, A. Bozec, E. Chassignet, G. Danabasoglu, S. Danilov, N. Diansky, H. Drange, P. G. Fogli, A. Gusev, A. Howard, M. Kelley, W. G. Large, A. Leboissetier, M. C. Long, J. Lu, S. Masina, A. Mishra, A. Navarra, A. J. G. Nurser, L. Patara, B. L. Samuels, D. Sidorenko, H. Tsujino, S. G. Yeager, and Q. Wang (2014), An assessment of Southern Ocean water masses and sea ice during 1988–2007 in a suite of interannual CORE-II simulations, *Ocean Modelling*, doi:10.1016/j.ocemod.2015.07.022.
  19. Lindsay, K., G. Bonan, S. C. Doney, F. Hoffman, D. M. Lawrence, M. C. Long, N. Mahowald, J. K. Moore, J. T. Randerson, and P. E. Thornton (2014), Preindustrial control and 20th Century experiments with the earth system model CESM1(BGC), *Journal of Climate*, 27(24), 8981–9005, doi:10.1175/JCLI-D-12-00565.1.
  20. Burd, A. B., S. Frey, A. Cabre, T. Ito, N. Levine, C. Lønborg, M. C. Long, M. Mauritz, R. Q. Thomas, B. Stevens, T. Vanwalleghem, and N. Zeng (2015), Terrestrial and marine perspectives on modeling organic matter degradation pathways, *Global Change Biology*, in press, doi:10.1111/gcb.12987.
  21. Farneti, R., S. M. Downes, S. M. Griffies, S. J. Marsland, D. Bailey, E. Behrens, M. Bentsen, D. Bi, A. Biastoch, C. Böning, A. Bozec, V. M. Canuto, E. Chassignet, G. Danabasoglu, S. Danilov, N. Diansky, H. Drange, P. G. Fogli, A. Gusev, R. W. Hallberg, A. Howard, M. Ilıcak, M. Kelley, W. G. Large, A. Leboissetier, M. C. Long, J. Lu, S. Masina, A. Mishra, A. Navarra, A. J. G. Nurser, L. Patara, B. L. Samuels, D. Sidorenko, H. Tsujino, P. Uotila,



- S. G. Yeager, and Q. Wang (2015), An assessment of Antarctic Circumpolar Current and Southern Ocean Meridional Overturning Circulation sensitivity during 1958–2007 in a suite of interannual CORE-II simulations, *Ocean Modelling*, doi:10.1016/j.ocemod.2015.07.009.
22. Ito, T., A. Bracco, C. Deutsch, H. Frenzel, M. C. Long, and Y. Takano (2015), Sustained growth of the Southern Ocean carbon storage in a warming climate, *Geophysical Research Letters*, 42, doi:10.1002/2015GL064320.
  23. Long, M. C., K. Lindsay, and M. M. Holland (2015), Modeling photosynthesis in sea ice covered waters, *Journal of Advances in Modeling Earth Systems*, 07(3), 1189–1206, doi:10.1002/2015MS000436.
  24. Lovenduski, N. S., M. C. Long, and K. Lindsay (2015), Natural variability in the surface ocean carbonate ion concentration, *Biogeosciences*, 12, 6321–6335, doi:10.5194/bg-12-6321-2015.
  25. Asher, E. C., J. W. H. Dacey, M. Stukel, M. C. Long, and P. D. Tortell (2016), Processes driving seasonal variability in DMS, DMSP, and DMSO concentrations and turnover in coastal Antarctic waters, *Limnology and Oceanography*, doi:10.1002/lno.10379.
  26. Bishop, S. P., P. R. Gent, F. O. Bryan, A. F. Thompson, M. C. Long, and R. Abernathy (2016), Southern Ocean Overturning Compensation in an Eddy-Resolving Climate Simulation, *Journal of Physical Oceanography*, 46(5), doi:10.1175/JPO-D-15-0177.1.
  27. Krumhardt, K. M., N. S. Lovenduski, M. C. Long, and K. Lindsay (2016), Avoidable impacts of ocean warming on marine primary production: Insights from the CESM ensembles, *Global Biogeochemical Cycles*, 30, doi:10.1002/2016GB005528.
  28. Long, M. C., C. A. Deutsch, and T. Ito (2016), Finding forced trends in oceanic oxygen, *Global Biogeochemical Cycles*, 30, doi:10.1002/2015GB005310.
  29. Lovenduski, N. S., G. A. McKinley, A. R. Fay, K. Lindsay, and M. C. Long (2016), Partitioning uncertainty in ocean carbon uptake projections: Internal variability, emission scenario, and model structure, *Global Biogeochemical Cycles*, 30, 1276–1287, doi:10.1002/2016GB005426.
  30. McKinley, G. A., D. J. Pilcher, A. R. Fay, K. Lindsay, M. C. Long, and N. Lovenduski (2016), Timescales for detection of trends in the ocean carbon sink, *Nature*, 530, 469–472, doi:10.1038/nature16958.
  31. Nevison, C. D., M. Manizza, R. F. Keeling, B. B. Stephens, J. D. Bent, J. Dunne, T. Ilyina, M. C. Long, L. Resplandy, J. Tjiputra, and S. Yukimoto (2016), Evaluating CMIP5 ocean biogeochemistry and Southern Ocean carbon uptake using atmospheric potential oxygen: Present-day performance and future projection, *Geophysical Research Letters*, doi:10.1002/2015GL067584.
  32. \*Eddebbar, Y. A., M. C. Long, L. Resplandy, C. Rödenbeck, K. B. Rodgers, M. Manizza, and R. F. Keeling (2017), Impacts of ENSO on air-sea oxygen exchange: Observations and mechanisms, *Global Biogeochemical Cycles*, 31(5), 901–921, doi:10.1002/2017gb005630.
  33. Hamme, R. C., S. R. Emerson, J. P. Severinghaus, M. C. Long, and I. Yashayaev (2017), Using noble gas measurements to derive air-sea process information and predict physical gas saturations, *Geophysical Research Letters*, 44(19), 9901–9909, doi:10.1002/2017gl075123.

34. Henson, S., C. Beaulieu, T. Ilyina, J. John, M. C. Long, R. Seferian, J. Tjiputra, and J. Sarmiento (2017), Rapid emergence of climate change in environmental drivers of marine ecosystem stress, *Nature Communications*, 8, doi:10.1038/NCOMMS14682.
35. Ito, T., S. Minobe, M. C. Long, and C. Deutsch (2017), Upper ocean O<sub>2</sub> trends: 1958-2015, *Geophysical Research Letters*, 44(9), 4214–4223, doi:10.1002/2017gl073613.
36. \*Rohr, T., M. C. Long, M. T. Kavanaugh, K. Lindsay, and S. C. Doney (2017), Variability in the mechanisms controlling Southern Ocean phytoplankton bloom phenology in an ocean model and satellite observations, *Global Biogeochemical Cycles*, doi:10.1002/2016GB005615.
37. \*Yang, S., N. Gruber, M. C. Long, and M. Vogt (2017), ENSO-Driven Variability of Denitrification and Suboxia in the Eastern Tropical Pacific Ocean, *Global Biogeochemical Cycles*, 31(10), 1470–1487, doi:10.1002/2016gb005596.
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#### Non-refereed Publications

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