

Curriculum Vitae

David Munro

Department of Atmospheric and Oceanic Sciences
Institute of Arctic and Alpine Research
University of Colorado at Boulder
Boulder, CO 80309

phone: 303.735.6582
david.munro@colorado.edu

EDUCATION

Ph.D., University of Washington, Chemical Oceanography, October 2012
Estimates of biological productivity in the coastal ocean using stable isotopes of oxygen and O₂:Ar gas ratios
Advisor: Paul D. Quay

M.S., Stanford University, Earth Systems, Oceans track, March 2004
Stable isotope composition of dissolved inorganic carbon and particulate organic carbon as tracers of biogeochemical processes in Antarctic sea ice
Advisor: Robert B. Dunbar

B.S., Stanford University, Earth Systems, Geosphere track, June 2000

RESEARCH

-Postdoctoral Research Fellow, Department of Atmospheric and Oceanic Sciences/INSTAAR, University of Colorado at Boulder, 2012 to present

-Research Assistant, Quay Stable Isotope Lab, 2005 to 2012
School of Oceanography, Seattle, WA

-Research Assistant, Dunbar Stable Isotope Lab, 2002 to 2004
Geological and Environmental Sciences, Stanford, CA

TEACHING

- Lecturer for Our Changing Environment – ATOC 1060 at U. Colorado, Boulder, Fall 2016
- Co-advised undergraduate research project on chlorophyll variability in the Southern Ocean, Fall 2015
- Advised summer undergraduate research project on dissolved O₂ in the Southern Ocean, Summer 2014
- Guest Lecturer for Biogeochemical Oceanography – ATOC 4200/5200 at U. Colorado, Boulder, Spring 2013, Spring 2014, Spring 2015
- Guest Lecturer for The Global Carbon Cycle – ATOC 5300 at U. Colorado, Boulder, Fall 2013

- Teaching Assistant for Introduction to Oceanography – Ocean 200 at U. Washington, Spring 2012
- Teaching Assistant for Deep Sea Exploration – Ocean 121 at U. Washington, Winter 2012
- Teaching Assistant for Ocean Circulation – Ocean 210 at U. Washington, Autumn 2011, 2010 and 2009
- Teaching Assistant for Chemical Oceanography – Ocean 400 at U. Washington, Winter 2010
- Teaching Assistant for Chemical Oceanography – Ocean 520 at U. Washington, Autumn 2008
- Tutor for Big Step, Milwaukee, WI, 2004 to 2005
- Grader for Earth Systems 10, Stanford, CA, Winter 2004
- Teaching Assistant for Earth Systems 10, Stanford, CA, Winter 2003
- Teaching Assistant for Stanford at SEA (Sea Education Association), Pacific Grove, CA; Pacific Ocean, Spring 2003
- SCA New Hampshire Parks Americorps Volunteer, Allenstown, NH, 2000 to 2001

HONORS, AWARDS, AND FELLOWSHIPS

- NASA Space Grant Graduate Fellowship, 2010
- National Defense Science and Engineering Graduate Fellowship (NDSEG), 2006-2009
- Program on Climate Change Graduate Fellowship, University of Washington, 2005-2006
- Excellence in Undergraduate Research Award, Earth Systems Program, Stanford University, 2000
- Antarctic Service Medal, awarded by the National Science Foundation with authorization from U.S. Congress, 2000
- Stanford Scholar Athlete, Golf, 1997

FUNDED PROPOSALS

Munro, D.R., N.S. Lovenduski, C. Sweeney, and B.B. Stephens, 2016-2019: Collaborative Research: Investigating biogeochemical fluxes and linkages to climate change with multi-scale observations in the Drake Passage. NSF Antarctic Ocean and Atmospheric Sciences, \$506,825 total award.

PUBLICATIONS

In Preparation:

Munro, D.R., P.D. Quay, N.S. Lovenduski, and G.E. Turi, Multi-decadal records of net biological production in the Southern California Current System based on dissolved oxygen and nitrate budgets. In preparation for *Limnol. Oceanogr.*

Munro, D.R., N.S. Lovenduski, T. Takahashi, B.B. Stephens, T. Newberger, H.M. Dierssen, K.L. Randolph, N.M. Freeman, S.M. Bushinsky, R.M. Key, J.L. Sarmiento, and C. Sweeney,

Geochemical Evidence for Calcification from the Drake Passage Time-series. In preparation for *J. Geophys. Res.*

In Review:

Fripiat, F., K.M. Meiners, M. Vancoppenolle, S.F. Ackley, K.R. Arrigo, G. Carnat, S. Cozzi, B. Delille, G.S. Dieckmann, R.B. Dunbar, H. Eicken, A. Fransson, H. Kennedy, D. Lannuzel, D.R. Munro, S. Papadimitriou, J.-M. Rintala, V. Schoemann, J. Stefels, N. Steiner, D.N. Thomas, and J.-L. Tison, Macro-nutrient concentrations in Antarctic pack ice: overall patterns and overlooked processes, *Elem. Sci. Anth.*

Published:

Quay, P.D., R. Sonnerup, D.R. Munro, and C. Sweeney (2016), Anthropogenic CO₂ Accumulation and Uptake Rates in the Pacific Ocean based on Changes in the ¹³C/¹²C of Dissolved Inorganic Carbon, *Glob. Biogeochem. Cycles*, doi:10.1002/2016GB005460

Le Quéré, C., R.M. Andrew, J.G. Canadell, S. Sitch, J.I. Korsbakken, G.P. Peters, A.C. Manning, T.A. Boden, P.P. Tans, R.A. Houghton, R.F. Keeling, S. Alin, O.D. Andrews, P. Anthoni, L. Barbero, L. Bopp, F. Chevallier, L.P. Chini, P. Ciais, K. Currie, C. Delire, S.C. Doney, P. Friedlingstein, T. Gkritzalis, I. Harris, J. Hauck, V. Haverd, M. Hoppema, K. Klein Goldewijk, A.K. Jain, E. Kato, A. Körtzinger, P. Landschützer, N. Lefèvre, A. Lenton, S. Lienert, D. Lombardozzi, J.R. Melton, N. Metzl, F. Millero, P.M.S. Monteiro, D.R. Munro, J.E.M.S. Nabel, S. Nakaoka, K. O'Brien, A. Olsen, A.M. Omar, T. Ono, D. Pierrot, B. Poulter, C. Rödenbeck, J. Salisbury, U. Schuster, J. Schwinger, R. Séférian, I. Skjelvan, B.D. Stocker, A.J. Sutton, T. Takahashi, H. Tian, B. Tilbrook, I.T. van der Laan-Luijkx, G.R. van der Werf, N. Viovy, A.P. Walker, A.J. Wiltshire, and S. Zaehle (2016), Global Carbon Budget 2016, *Earth Syst. Sci. Data*, doi:10.5194/essd-8-605-2016

Bakker, D.C.E., B. Pfeil, C.S. Landa, N. Metz, K.M. O'Brien, A. Olsen, K. Smith, C. Cosca, S. Harasawa, S.D. Jones, S. Nakaoka, Y. Nojiri, U. Schuster, T. Steinhoff, C. Sweeney, T. Takahashi, B. Tilbrook, C. Wada, R. Wanninkhof, S.R. Alin, C.F. Balestrini, L. Barbero, N.R. Bates, A.A. Bianchi, F. Bonou, J. Boutin, Y. Bozec, E.F. Burger, W.-J. Cai, R.D. Castle, L. Chen, M. Chierici, K. Currie, W. Evans, C. Featherstone, R.A. Feely, A. Fransson, C. Goyet, N. Greenwood, L. Gregor, S. Hankin, N.J. Hardman-Mountford, J. Harlay, J. Hauck, M. Hoppema, M.P. Humphreys, C.W. Hunt, B. Huss, J.S.P. Ibáñez, T. Johannessen, R. Keeling, V. Kitidis, A. Körtzinger, A. Kozyr, E. Krasakopoulou, A. Kuwata, P. Landschützer, S.K. Lauvset, N. Lefèvre, C. Lo Monaco, A. Manke, J.T. Mathis, L. Merlivat, F.J. Millero, P.M.S. Monteiro, D.R. Munro, A. Murata, T. Newberger, A.M. Omar, T. Ono, K. Paterson, D. Pearce, D. Pierrot, L.L. Robbins, S. Saito, J. Salisbury, R. Schlitzer, B. Schneider, R. Schweitzer, R. Sieger, I. Skjelvan, K.F. Sullivan, S.C. Sutherland, A.J. Sutton, K. Tadokoro, M. Telszewski, M. Tuma, S.M.A.C. van Heuven, D. Vandemark, B. Ward, A.J. Watson, and S. Xu (2016), A multi-decade record of high-quality fCO₂ data in version 3 of the Surface Ocean CO₂ Atlas (SOCAT), *Earth Syst. Sci. Data*, doi:10.5194/essd-8-383-2016

Song, H., J. Marshall, D.R. Munro, S. Dutkiewicz, C. Sweeney, D.J. McGillicuddy Jr. and U. Hausmann (2016), Mesoscale modulation of air-sea CO₂ flux in Drake Passage. *J. Geophys. Res.*, doi:10.1002/2016JC011714

Eveleth, R., N. Cassar, S.C. Doney, D.R. Munro, and C. Sweeney (2016), Biological and physical controls on O₂/Ar, Ar and pCO₂ variability at the Western Antarctic Peninsula and Drake Passage, *Deep Sea Res. II*, doi:10.1016/j.dsr2.2016.05.002

Le Quéré, C., R. Moriarty, R.M. Andrew, J.G. Canadell, S. Sitch, J.I. Korsbakken, P. Friedlingstein, G.P. Peters, R.J. Andres, T.A. Boden, R.A. Houghton, J.I. House, R.F. Keeling, P. Tans, A. Arneeth, D.C.E. Bakker, L. Barbero, L. Bopp, J. Chang, F. Chevallier, L.P. Chini, P. Ciais, M. Fader, R.A. Feely, T. Gkritzalis, I. Harris, J. Hauck, T. Ilyina, A.K. Jain, E. Kato, V. Kitidis, K. Klein Goldewijk, C. Koven, P. Landschützer, S.K. Lauvset, N. Lefèvre, A. Lenton, I.D. Lima, N. Metzl, F. Millero, D.R. Munro, A. Murata, J.E.M.S. Nabel, S. Nakaoka, Y. Nojiri, K. O'Brien, A. Olsen, T. Ono, F.F. Pérez, B. Pfeil, D. Pierrot, B. Poulter, G. Rehder, C. Rödenbeck, S. Saito, U. Schuster, J. Schwinger, R. Séférian, T. Steinhoff, B.D. Stocker, A.J. Sutton, T. Takahashi, B. Tilbrook, I.T. van der Laan-Luijkx, G.R. van der Werf, S. van Heuven, D. Vandemark, N. Viogy, A. Wiltshire, S. Zaehle, and N. Zeng (2015), Global Carbon Budget 2015, *Earth Syst. Sci. Data*, doi:10.5194/essd-7-349-2015

Munro, D.R., N.S. Lovenduski, T. Takahashi, B.B. Stephens, T. Newberger, and C. Sweeney (2015), Recent evidence for a strengthening CO₂ sink in the Southern Ocean from carbonate system measurements in the Drake Passage (2002 – 2015), *Geophys. Res. Lett.*, doi:10.1002/2015GL065194

- [Science perspective: An increasing carbon sink?](#)

- [Christian Science Monitor: Nature's global warming 'sink' isn't clogged anymore, studies say](#)

- [Press release: Scientists find Southern Ocean removing CO₂ from the atmosphere more efficiently](#)

Munro, D.R., N.S. Lovenduski, B.B. Stephens, K.R. Arrigo, T. Newberger, T. Takahashi, P.D. Quay, J. Sprintall, N.M. Freeman, and C. Sweeney (2015), Estimates of net community production in the Southern Ocean determined from time series observations (2002 – 2011) of nutrients, dissolved inorganic carbon, and surface ocean pCO₂ in Drake Passage, *Deep Sea Res. II*, doi:10.1016/j.dsr2.2014.12.014

Takahashi, T., S.C. Sutherland, D.W. Chipman, J.G. Goddard, C. Ho, T. Newberger, C. Sweeney, and D.R. Munro (2014), Climatological distributions of pH, pCO₂, total CO₂, alkalinity, and CaCO₃ saturation in the global surface ocean, and temporal changes at selected locations, *Mar. Chem.*, doi:10.1016/j.marchem.2014.06.004

Munro, D.R., P.D. Quay, L.W. Juranek, and R. Goericke (2013), Biological production rates off the Southern California coast estimated from triple O₂ isotopes and O₂:Ar gas ratios, *Limnol. Oceanogr.*, doi:10.4319/lo.2013.58.4.1312

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, *J. Geophys. Res.*, doi:10.1029/2009JC005661

SELECTED PRESENTATIONS

Munro, D.R., N.S. Lovenduski, T. Takahashi, B.B. Stephens, T. Newberger, H.M. Dierssen, K.L. Randolph, N.M. Freeman, S.M. Bushinsky, R.M. Key, J.L. Sarmiento, and C. Sweeney (2016) Geochemical Evidence for Calcification from the Drake Passage Time-series, AGU Fall Meeting, San Francisco, CA.

Munro, D.R., C. Sweeney, T. Newberger, and A. Jacobson (2016) Atmospheric CO₂ over the ocean, NOAA ESRL Carbon Cycle Seminar, Boulder, CO.

Munro, D.R., N.S. Lovenduski, T. Takahashi, B.B. Stephens, T. Newberger, and C. Sweeney (2016) Recent evidence for a strengthening CO₂ sink in the Southern Ocean from carbonate system measurements in the Drake Passage (2002-2015), AGU/ASLO Ocean Sciences, New Orleans, LA.

Munro, D.R., N.S. Lovenduski, T. Takahashi, B.B. Stephens, T. Newberger, and C. Sweeney (2015) Recent evidence for a strengthening CO₂ sink in the Southern Ocean from carbonate system measurements in the Drake Passage (2002-2015), NOAA ESRL Carbon Cycle Seminar, Boulder, CO.

Munro, D.R., N.S. Lovenduski, T. Takahashi, B.B. Stephens, T. Newberger, and C. Sweeney (2015) Recent change in the Southern Ocean carbon system based on time series observations in the Drake Passage, OCB Summer Workshop, Woods Hole, MA.

Munro, D.R., N.S. Lovenduski, T. Takahashi, B.B. Stephens, T. Newberger, and C. Sweeney (2015) Recent change in the Southern Ocean carbon system based on time series observations in the Drake Passage. The 7th International Symposium on Gas Transfer at Water Surfaces. Seattle, WA.

Sprintall, J., T.K. Chereskin, C. Sweeney, D.R. Munro, and B.B. Stephens (2015) Year-round time-series from underway shipboard measurements in Drake Passage. Linde Workshop on Southern Ocean Dynamics and Biogeochemistry. CalTech, Pasadena, CA.

Munro, D.R., N.S. Lovenduski, C. Sweeney, T. Takahashi, B.B. Stephens, and T. Newberger (2014) Recent change in the Southern Ocean carbon system based on time series observations in the Drake Passage, Joint US CLIVAR and OCB Workshop, San Francisco, CA.

Munro, D.R. (2014), Estimates of net community production in Drake Passage, NOAA ESRL Carbon Cycle Seminar, Boulder, CO.

Munro, D.R., N.S. Lovenduski, B.B. Stephens, T. Newberger, K.R. Arrigo, T. Takahashi, P.D. Quay, and C. Sweeney (2014), Estimates of net community production in Drake Passage, AGU/ASLO Ocean Sciences, Honolulu, HI.

Munro, D.R. (2013), The distribution of radiocarbon in Drake Passage, NCAR CESM Workshop, Breckenridge, CO.

Munro, D.R. (2013), The distribution of radiocarbon and $\delta^{13}\text{C}$ of dissolved inorganic carbon in Drake Passage, NCAR Workshop on Southern Ocean, Boulder, CO.

Munro, D.R. (2013), Biological production in the California Current, NOAA ESRL Carbon Cycle Seminar, Boulder, CO.

Munro, D.R. (2012), Biological production in the California Current, University of Colorado Department of Atmospheric and Oceanic Sciences Seminar, Boulder, CO.

Munro, D.R., and P.D. Quay (2012), Multi-decadal record of net biological production in the Southern California Current based on O_2 and nitrate budgets, AGU/ASLO Ocean Sciences, Salt Lake City, UT.

Munro, D.R., and P.D. Quay (2010), Gross and Net Production Estimates in the California Current System from Oxygen Triple Isotopes and the O_2/Ar Ratio, AGU Fall Meeting, San Francisco, CA.

Munro, D.R. (2010), Estimates of Primary Production and Net Community Production in the Coastal Ocean: Application of the ^{17}O -GOP and O_2/Ar NOP Methods to Three Distinct Continental Margin Settings, Dissertations in Chemical Oceanography Symposium, Honolulu, HI.

Munro, D.R., P.D. Quay, and G.E. Friederich (2010), Gross and Net Production Estimates in the Coastal Ocean from Oxygen Triple Isotopes and the O_2/Ar Ratio, AGU/ASLO Ocean Sciences, Portland, OR.

Munro, D.R., P.D. Quay, and G.E. Friederich (2009), Application of Natural Abundance Isotopes of Dissolved Oxygen and the O_2/Ar Ratio to Estimate Gross and Net Production in Eastern Boundary Current Systems, Gordon Research Conference – Chemical Oceanography, Tilton, NH.

Munro, D.R. (2009), Estimates of Primary Production and Carbon Export in the Southern California Bight, University of Washington Chemical Oceanography Seminar, Seattle, WA.

Juranek, L., P. Quay, D. Munro, and C. Peacock (2008), Validation of Satellite Primary Productivity Estimates Using Measurements of the Oxygen Isotope Composition of Dissolved O_2 , NASA Conference, Greenbelt, MD.

Munro, D.R., and P.D. Quay (2008), Implications of Oxygen Isotope-Based Gross Primary Production Rates to Carbon Cycling off the Coast of Southern California, AGU/ASLO Ocean Sciences, Orlando, FL.

Dunbar, R.B., D.A. Mucciarone, L. Federici, D. Munro, L. Rogers, M. Long, E. Costa, J. Villinski, J. Hayes, A. Leventer, E.W. Domack, C. Riesselman, C. Moy, K. Theissen, and M. Lutz (2007), A circum-Antarctic synthesis of stable carbon isotope variability in Southern Ocean sedimentary sections: Insights from the modern ocean, 10th International Symposium on Antarctic Earth Sciences, Santa Barbara, CA.

Munro, D.R. (2007), In Situ Measurements of Primary Production in the Coastal Ocean, University of Washington Chemical Oceanography Seminar, Seattle, WA.

Munro, D.R., P.D. Quay, and L.W. Juranek (2006) Comparison of Gross Primary Production from $^{17}\Delta$ of Dissolved O₂ with CalCOFI ^{14}C Primary Production, CalCOFI Conference, Asilomar, CA.

Munro, D.R., R.B. Dunbar, D.A. Mucciarone, K.R. Arrigo, and M. Lizotte (2000), Nutrient Concentrations and Isotopic Composition of Inorganic Carbon and Particulate Organic Material in Sea Ice Brine from the Ross Sea, Antarctica, AGU/ASLO Ocean Sciences, San Antonio, TX.

REVIEWER FOR

- Biogeosciences
- Deep Sea Research I
- Geophysical Research Letters
- Global Biogeochemical Cycles
- Journal of Geophysical Research
- Limnology and Oceanography

PROFESSIONAL ORGANIZATIONS

- American Geophysical Union
- American Society of Limnology and Oceanography

OCEANOGRAPHIC CRUISES

November 2009 Mid-Atlantic Bight/Gulf of Maine; R/V Delaware II; collected O₂ isotope, O₂/Ar, and DI¹³C samples

August 2008 CalCOFI – Southern California Bight; R/V New Horizon; collected O₂ isotope, O₂/Ar, and DI¹³C samples; assisted with standard CalCOFI measurements including chlorophyll, POC, and HPLC samples

February 2008 Dakar, Senegal to Cape Verde Islands; R/V Atalante; collected O₂ isotope, O₂/Ar, and DI¹³C samples

March 2007 Transit Cruise Seattle-San Diego; R/V Thomas G. Thompson; collected O₂ isotope, O₂/Ar, and DI¹³C samples

July 2006 CalCOFI – Southern California Bight; R/V New Horizon; collected O₂ isotope, O₂/Ar, and DI¹³C samples; assisted with standard CalCOFI measurements including chlorophyll, POC, and HPLC samples

April 2006 CalCOFI – Southern California Bight; R/V New Horizon; collected O₂ isotope, O₂/Ar, and DI¹³C samples; assisted with standard CalCOFI measurements including chlorophyll, POC, and HPLC samples

November 2005 CalCOFI – Southern California Bight; R/V New Horizon; collected O₂ isotope, O₂/Ar, and DI¹³C samples; assisted with standard CalCOFI measurements including chlorophyll, POC, and HPLC samples

May 2003 Honolulu, HI to Line Islands and back; SSV Robert C. Seamans; assisted undergraduates with research projects; collected gravity core at Palmyra Atoll

November – December 1998 Ross Sea, Antarctica; RV/IB Nathaniel B. Palmer; assisted in the collection of DIC and DI¹³C samples; conducted an individual research project on the chemical composition of sea ice brines extracted from pack ice