

## CURRICULUM VITAE

### **JAMES R. LEDWELL**

Senior Scientist  
Department of Applied Ocean Physics and Engineering  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

### **Education**

Ph.D. Applied Physics, Harvard University, 1982  
M.S. Applied Physics, Harvard University, 1979  
M.S. Physics, University of Massachusetts at Amherst, 1974  
B.S. Physics, Boston College, 1970

Ph.D. Thesis: Gas Exchange Across the Air-Water Interface, Michael B. McElroy, Advisor

### **Awards**

Senior Scientist Leadership Prize, WHOI, 2013  
Elected AGU Fellow, 2011  
Alexander Agassiz Medal, National Academy of Sciences, 2007  
Edward W. and Betty J. Scripps Senior Scientist Chair, WHOI, 2002

### **Employment History**

2015 – Emeritus Research Scholar, Woods Hole Oceanographic Institution  
2000 – 2015 Senior Scientist, Woods Hole Oceanographic Institution  
1990 – 2000 Associate Scientist, Woods Hole Oceanographic Institution  
1988 – 1990 Research Scientist and Adjunct Associate Professor, Lamont-Doherty Earth  
Observatory Columbia University  
1985 - 1988 Associate Research Scientist, Lamont-Doherty Earth Observatory, Columbia  
University  
1983 - 1985 NCR-NASA Resident Research Associate, Goddard Institute for Space Studies  
1982 - 1983 Associate Research Scientist, Lamont-Doherty Earth Observatory, Columbia  
University  
1976 - 1982 Graduate Research Assistant, Harvard University  
1971 - 1976 Teaching Assistant, University of Massachusetts at Amherst

### **Membership in Scientific Societies**

American Geophysical Union  
American Meteorological Society  
The Oceanography Society

## Educational Activities

Postdoctoral Fellow Advisor: Patrick Ryan Jackson 2006/07

Principal thesis advisor for: Miles Sundermeyer, Ph.D. 1998  
Jody Katrein, M.S. 2001

Advisor for Jesse Cusack, exchange student from University of Southampton, fall 2015

Advisor for Hao Zuo, exchange student from University of Southampton, summer 2007

Advisor, Summer Student Fellows, 1999, 2001, 2005, 2012, WHOI

Participant, Summer Study Program in Geophysical Fluid Dynamics, 1999, Woods Hole

Tracer Transport in Geophysical Fluids, 1989 (A graduate course at Columbia University)

Participant, Summer Study Program in Geophysical Fluid Dynamics, 1989, Woods Hole

Member of the following thesis committees, or chair of the defense in the MIT/WHOI Joint Program:

Rebecca Walsh Dell	Ph.D. (Physical Oceanography, Chair of the Defense)	2012
Max Nikurashin	Ph.D. (Physical Oceanography)	2004 – 2008
Rachel Stanley	Ph.D. (Marine Geochemistry and Chemistry)	2003 – 2007
Maria Hood	Ph.D. (Marine Geochemistry and Chemistry)	1993 – 1997
Lou St. Laurent	Ph.D. (Physical Oceanography)	1996 – 1999
Sean McKenna	Ph.D. (Applied Ocean Physics and Engineering)	1999 – 2000
Dan McDonald	Ph.D. (AOP&E, Chair of the defense)	2002

Member of the following thesis committees at Columbia University:

Rik Wanninkhof	Ph.D. (Geochemistry)	1982 – 1986
Edward Garvey	Ph.D. (Geochemistry)	1989
Amy Ffield	MA (Physical Oceanography)	1987 – 1990
Hua Chen	MA (Geochemistry)	1987 – 1990
Kate Bosely	Ph.D. (Physical Oceanography)	1986 – 1991
John Crusius	Ph.D. (Geochemistry)	1985 – 1990

## Field Experience

DIMES Sampling, Southern Ocean, (Andrew Meijers, PSO) 49-day cruise, RRS *James Clark Ross*, 8 March – 26 April, 2014

DIMES Sampling, Drake Passage, (Lou St Laurent, Chief Scientist) 18-day cruise, R/V *Nathaniel B. Palmer*, 26 October - 13 November 2013

GISR tracer sampling, Gulf of Mexico, Chief Scientist  
21-day cruise, R/V *Pelican*, 29-November - 20 December 2012

GISR tracer sampling, Gulf of Mexico, Chief Scientist  
28-day cruise, R/V *Pelican*, 31 July – 27 August 2013

GISR tracer injection and initial sampling, Gulf of Mexico, Chief Scientist  
17-day cruise, R/V *Brooks McCall*, 26 July – 10 August 2012

Lateral Mixing DRI Cruise, Western Atlantic, Chief Scientist,

21-day cruise, R/V *Cape Hatteras*, 1-21 June 2011  
 DIMES Sampling, Drake Passage, Chief Scientist,  
 8-day cruise, R/V *Lawrence M. Gould*, 12-20 August 2011  
 DIMES Sampling, Drake Passage (Andrew Watson PSO)  
 17-day cruise, RRS *James Clark Ross*, 9-26 April 2011  
 DIMES Sampling, Drake Passage (Michael Meredith PSO)  
 39-day cruise, RRS *James Cook*, 30 Nov 2010 – 8 Jan 2011  
 Dye experiment test for LatMix, Sargasso Sea, Chief Scientist,  
 7-day cruise, R/V *Cape Hatteras*, 2-9 August 2010  
 DIMES sampling, Southeast Pacific, Chief Scientist,  
 50-day cruise, R/V *Thomas G. Thompson*, 15 Jan – 5 March 2010  
 DIMES deployment, Southeast Pacific, Chief Scientist,  
 45-day cruise, R/V *Roger Revelle*, 10 Jan - 23 Feb 2009  
 Airborne LIDAR test, Sargasso Sea, Chief Scientist,  
 6-day cruise, R/V *Walton Smith*, 7-12 Sep 2008  
 LADDER-2, Tracer survey in LADDER on East Pacific Rise, Chief Scientist,  
 26-day cruise, R/V *Atlantis*, Dec 2006 - Jan 2007  
 Tracer and CTD operations, LADDER-1, Tracer injection on East Pacific Rise  
 24-day cruise, R/V *Atlantis*, Oct - Nov, 2006 (L. Mullineaux, Chief Sci)  
 Development of SF5CF3 for Tracer Release Experiments, Chief Scientist,  
 14-day cruise, R/V *Robert Gordon Sproul*, January, 2005  
 7-day cruises, R/V *Robert Gordon Sproul*, June, 2005; January 2006  
 Tracer component of EDDIES project, Chief Scientist,  
 17-day cruise, R/V *Oceanus*, July, 2005  
 16-day cruise, R/V *Oceanus*, September, 2005  
 Salt Finger Tracer Release Experiment:  
 13-day cruise on R/V *Oceanus*, 2003, Chief Scientist,  
 13-day cruise on R/V *Seward Johnson*, 2003, Chief Scientist,  
 30-day cruise on R/V *Oceanus*, 2001 (R. Schmitt, Chief Sci.)  
 49-day cruise, R/V *Seward Johnson*, 2001 (R. Schmitt, Chief Sci.)  
 Brazil Basin Tracer Release Experiment, Chief Scientist,  
 Three 35-day cruises, R/V *Seward Johnson*, 1996, 1997, and 1998  
 40-day cruise, R/V *Knorr*, 2000  
 GLOBEC, 33-day cruise, , Chief Scientist, R/V *Endeavor 323/324*, 1999  
 Sampling for Greenland Sea Tracer Release Experiment, 50-day cruise, FS *Polarstern*, 1998 (E. Fahrbach, Chief Sci.)  
 Coastal Mixing and Optics Tracer Studies, Chief Scientist,  
 5-day cruise, 1995  
 Two 15-day cruises, R/V *Oceanus*, 1996 and 1997  
 North Atlantic Tracer Release Experiment:  
 Two 5-day Test cruises, R/V *Oceanus* 1990 and 1991, Chief Scientist  
 3-week Release cruise, R/V *Oceanus* 1992, Chief Scientist  
 3-week Sampling cruise, RRS *Charles Darwin*, 1992 (A. Watson, PSO)  
 1-month Sampling cruise, R/V *Oceanus* 1992, Chief Scientist  
 1-month Sampling cruise, R/V *Oceanus* 1992 (N. Oakey, Chief Sci.)

1 month Sampling cruise, CSS *Hudson*, 1993 (N. Oakey, Chief Sci.)  
1-month Sampling cruise, RRS *Charles Darwin*, 1993 (A. Watson, PSO)  
1-month Sampling cruise, R/V *Seward Johnson*, 1994, Chief Scientist)  
Santa Cruz Basin Tracer Experiment, six cruises, Chief Scientist, 63 days, R/V *Robert Gordon Sproul*, 1988 and 1989  
Chief Scientist, Santa Monica Basin Tracer Experiment, three sampling cruises, Chief Scientist, 38 days, R/V *Robert Gordon Sproul*, 1985 and 1986  
Chief Scientist, San Nicolas Basin Tracer Test Cruise, Chief Scientist, 5 days, R/V *New Horizon*, June, 1985  
CO2/XBT sampling from TFL *Jefferson*, LeHavre to Boston, 8 days, January, 1983

### **External Committees Served**

NSF Advisory Committee on Ocean Carbon Cycle Research, 2001 – 2003  
NSF Workshop on the Future of Physical Oceanography (APROPOS), Steering Committee 1997-1998  
U.S. WOCE Scientific Steering Committee, 1987-1991

### **Recent Talks**

AmeriMech Symposium on Fluid Transport and Nonlinear Dynamics, Woods Hole, “Stirring of Tracers within the Stratified Ocean”, 17 May 2016.  
Marine Research Institute, Reykjavik, “DIMES: A study of stirring and mixing in the Southern Ocean, 23 June 2016.  
WHOI, AOPE, “A Stirring Career, Studies of Mixing and Stirring in the Ocean”, 16 September 2015.  
NSF, “Diapycnal and Isopycnal Mixing Experiment in the Southern Ocean: Summary of Results so far”, 2 April 2015.  
Royal Society Discussion Meeting, “Diapycnal Mixing from Coordinated Tracer and Microstructure Measurements”, 16 July 2013  
NCSU, “A Tracer Experiment in the Gulf of Mexico”, 4 June 2013  
TAMU, “A Tracer Experiment in the Gulf of Mexico,” 1 May 2013  
MIT, “DIMES Diapycnal mixing Studies”, 28 January 2013  
AOMIP Workshop, WHOI, “Prospective Tracer Release Experiments in the Arctic”, 24 October 2012  
UEA, “Diapycnal Mixing in the Ocean: Is there much?”, 5 November 2012  
UMass Dartmouth, “Stirring and Mixing in the Southern Ocean”, 11 April 2012  
P.O. Seminar, WHOI, “Mixing of a Tracer in the ACC”, 29 November 2011  
OCCI Series at WHOI, "Mixing in the ACC", 31 March 2011  
University of Kiel Retreat, Lubeck, "A Tracer Study of Mixing in the ACC", 21 February 2011  
Comer Climate Symposium, "Diapycnal Mixing and the MOC", 18 September 2011

### **Recent Conferences and Project Workshops**

AmeriMech Symposium on Fluid Transport and Nonlinear Dynamics, Woods Hole, 17-20 May 2016.

Ocean Sciences, New Orleans, 22-26 February, 2016.

Gulf of Mexico Oil Spill and Ecosystem Science Conference, Tampa, Florida, 1-4 February 2016.

Diapycnal and Isopycnal Mixing Experiment in the Southern Ocean (DIMES):

International Workshop, Woods Hole, 13-15 November, 2012, Convener

International Workshop, Scripps Institution of Oceanography, 20-21 November, 2013

UK Workshop, Paris, France, 7-8 July 2014

International Workshop, Exeter University, 13-14 November, 2014

International Workshop, WHOI, 2-3 June 2015

International Workshop, Reykjavik, 21-23 June, 2016

Gulf Integrated Spill Response Consortium (GISR)

PI Meeting, 20 January 2013, New Orleans, Louisiana

PI meeting, 30 January 2014, Mobile, Alabama

ONR/DRI Planning meetings: Scalable Lateral Mixing and Coherent Turbulence

Seattle, 8-9 Dec 2009, Boston, 28-30 May, 2008, Monterey, 9-11, 2008.

UCLA, 15-16 February, 2011

Portland, OR, January, 2012

Woods Hole, June, 2012, Convener

Stanford, January, 2013

Hawaii, February, 2014, Convener

MARVEL: Marianas Vent Larvae Workshop, Okinawa, Japan, May 2012

Eddies Mixing, Dynamics, Export, and Species Composition (EDDIES) Workshop, 15-17 February 2006, Hawaii

### **Recent Internal WHOI Service**

Lab Head, Coastal and Ocean Fluid Dynamics Laboratory, AOPE, 2003-2014

AOPE Post Doc Advisory Committee, Member, 2008-2011; Chair, 2011-2015

Marine Operations Committee, 2006-2015

Defined Contribution Retirement Plan Committee, 2013-2015

## Publications in Refereed Journals

- Mashayek, A., R. Ferrari, S. Merrifield, J. R. Ledwell, L. St. Laurent, and A. Naveira Garabato (2017), Topographic enhancement of vertical mixing in the Southern Ocean, *Nature Communications*, 8, doi:10.1038/ncomms14197.
- Ozgekmen, T.M., E.P. Chassignet, C.N. Dawson, D. Dukhovskoy, G. Jacobs, J. Ledwell, O. Garcia-Pineda, I.R. MacDonald, S.L. Morey, M.J. Olascoaga, A.C. Poje, K. Reed, and J. Skancke, Over what area did the oil and gas spread during the 2010 Deepwater Horizon oil spill?, *Oceanography* 29(3):96-107, <http://dx.doi.org/10.5670/oceanog.2016.74>.
- Ledwell, J. R., R. He, Z. Xue, S. F. DiMarco, L. Spencer, and P. Chapman, Dispersion of a tracer in the deep Gulf of Mexico, *J. Geophys. Res. Oceans*, 121, 1110-1132, doi:10.1002/2015JC011405, 2016.
- Boland, E. J. D., E. Shuckburgh, P. H. Haynes, J. R. Ledwell, M.-J. Messias, and A. J. Watson, Determining a sub-mesoscale diffusivity using a roughness measure applied to a tracer release experiment in the Southern Ocean, *J. Phys. Oceanogr.*, 45, 1610-1631, <http://dx.doi.org/10.1175/JPO-D-14-0047.1>, 2015.
- Shcherbina, A. Y., M. A. Sundermeyer, E. Kunze, E. D'Asaro, G. Badin, Daniel Birch, A.-M. E. G. Brunner-Suzuki, J. Callies, B. T. Kuebel Cervantes, M. Claret, B. Concannon, J. Early, R. Ferrari, L. Goodman, R. R. Harcourt, J. M. Klymak, C. M. Lee, M.-P. Lelong, M. D. Levine, R-C Lien, A. Mahadevan, J. C. McWilliams, M. J. Molemaker, S. Mukherjee, J. D. Nash, T. Özgökmen, S. D. Pierce, S. Ramachandran, R. M. Samelson, T. B. Sanford, R. K. Shearman, E. D. Skillingstad, K. S. Smith, A. Tandon, J. R. Taylor, E. A. Terray, L. N. Thomas, J. R. Ledwell, (2015), The LatMix summer campaign: Submesoscale stirring in the upper ocean, *Bull. Am. Meteorol. Soc.*, <http://dx.doi.org/10.1175/BAMS-D-14-00015.1>
- Tulloch, R., R. Ferrari, O. Jahn, A. Klocker, J. LaCasce, J. R. Ledwell, and J. Marshall, M.-J. Messias, K. Speer, and A. J. Watson, Direct estimate of lateral eddy diffusivity upstream of Drake Passage, *J. Phys. Oceanogr.*, 44, 2593-2616, doi: <http://dx.doi.org/10.1175/JPO-D-13-0120.1>, 2014.
- Watson, A. J., J. R. Ledwell, M.-J. Messias, N. Mackay, M. P. Meredith, B. Mills, and A. C. Naveira Garabato, Rapid cross-density ocean mixing at mid depths in Drake Passage, *Nature*, 501(7467), 2013.
- Sheen, K. L., J. A. Brearley, A. C. Naveira Garabato, D. A. Smeed, S. Waterman, J. R. Ledwell, M. P. Meredith, L. St. Laurent, A. M. Thurnherr, J. M. Toole, and A. J. Watson, Rates and mechanisms of turbulent dissipation and mixing in the Southern Ocean: Results from the Diapycnal and Isopycnal Mixing Experiment in the Southern Ocean (DIMES), *J. Geophys. Res. Oceans*, 118, 2774-2792, doi:10.1002/jgrc.20217, 2013.

- Mullineaux, L. S., D. J. McGillicuddy, Jr., S. W. Mills, V. K. Kosneyrev, A. M. Thurnherr, J. R. Ledwell, and J. W. Lavelle, Active positioning of vent larvae at a mid-ocean ridge, *Deep-Sea Res. Part II*, 92, 46-57, doi:http://dx.doi.org/10.1016/j.dsr2.2013.03.032, 2013.
- St. Laurent, L. C., A. C. Naveira Garabato, J. R. Ledwell, A. M. Thurnherr, J. M. Toole, and A. J. Watson, Turbulence and diapycnal mixing in Drake Passage, *J. Phys. Oceanogr.*, 42(12), 2143-2152, doi:http://dx.doi.org/10.1175/JPO-D-12-027.1, 2012.
- Rye, C. D., M.-J. Messias, J. R. Ledwell, A. J. Watson, A. Brousseau, and B. A. King, Diapycnal diffusivities from a tracer release experiment in the deep sea, integrated over 13 years, *Geophys. Res. Lett.*, 39(4), L04603, 4 pp., doi:10.1029/2011GL050294, 2012.
- Lavelle, J. W., A. M. Thurnherr, L. S. Mullineaux, D. J. McGillicuddy, Jr., and J. R. Ledwell, The prediction, verification, and significance of flank jets at mid-ocean ridges, *Oceanography*, 25(1), 277-283, doi:http://dx.doi.org/10.5670/oceanog.2012.26, 2012.
- Thurnherr, A. M., J. R. Ledwell, J. W. Lavelle, and L. S. Mullineaux, Hydrography and circulation near the crest of the East Pacific Rise between 9°N and 10°N, *Deep-Sea Res. Part I*, 58(4), 365–376, doi:http://dx.doi.org/10.1016/j.dsr.2011.01.009, 2011.
- Ledwell, J.R., L. C. St. Laurent, J. B. Girton, and J. M. Toole, Diapycnal mixing in the Antarctic Circumpolar Current, *J. Phys. Oceanogr.*, 41, 241–246, doi:http://dx.doi.org/10.1175/2010JPO4557.1, 2011.
- Lavelle, J. W., A. M. Thurnherr, J. R. Ledwell, D. J. McGillicuddy Jr., and L. S. Mullineaux, Deep ocean circulation and transport where the East Pacific Rise at 9–10°N meets the Lamont seamount chain, *J. Geophys. Res.*, 115(C12), C12073, doi:10.1029/2010JC006426, 2010.
- Jackson, P. R., J. R. Ledwell, and A. M. Thurnherr, Dispersion of a tracer on the East Pacific Rise (9°N to 10°N), including the Influence of hydrothermal plumes, *Deep-Sea Res. Part I*, 57(1), 37–52, doi:http://dx.doi.org/10.1016/j.dsr.2009.10.011, 2010.
- Ledwell, J. R., D. J. McGillicuddy, Jr., and L. A. Anderson, Nutrient flux into an intense deep chlorophyll layer in a mode-water eddy, *Deep-Sea Res., Part II*, 55(10-13), 1139–1160, doi:http://dx.doi.org/10.1016/j.dsr2.2008.02.005, 2008.
- Ho, D. T., J. R. Ledwell, and W. M. Smethie, Jr., Use of SF<sub>5</sub>CF<sub>3</sub> for ocean tracer release experiments, *Geophys. Res. Lett.*, 35(4), L04602, doi:10.1029/2007GL032799, 2008.
- Messias, M.-J., A. J. Watson, T. Johannessen, K. I. C. Oliver, K. A. Olsson, E. Fogelqvist, J. Olafsson, S. Bacon, J. Balle, N. Bergman, G. Budéus, M. Danielsen, J. -C. Gascard, E. Jeansson, S. R. Ólafsdóttir, K. Simonsen, T. Tanhua, K. Van Scoy, and J. R. Ledwell, The Greenland Sea Tracer Experiment 1996-2002: Horizontal mixing and transport of Greenland Sea Intermediate Water, *Progr. Oceanogr.*, 78, 85–105, doi:doi:10.1016/j.pocean.2007.06.005, 2008.

- Sundermeyer, M. A., E. A. Terray, J. R. Ledwell, A. G. Cunningham, P. E. LaRocque, J. Banic, and W. J. Lillycrop, Three-dimensional mapping of fluorescent dye using a scanning, depth-resolving airborne Lidar, *J. Atmos. Oceanic Tech.*, 24(6), 1050–1065, doi:<http://dx.doi.org/10.1175/JTECH2027.1>, 2007.
- McGillicuddy Jr., D. J., L. A. Anderson, N. R. Bates, T. Bibby, K. O. Buesseler, C. Carlson, C. S. Davis, C. Ewart, P. G. Falkowski, S. A. Goldthwait, D. A. Hansell, W. J. Jenkins, R. Johnson, V. K. Kosnyrev, J. R. Ledwell, Q. P. Li, D. A. Siegel, and D. K. Steinberg, Eddy/wind interactions stimulate extraordinary mid-ocean plankton blooms, *Science*, 316(5827), 1021–1026, doi:10.1126/science.1136256, 2007.
- Schmitt, R. W., J. R. Ledwell, E. T. Montgomery, K. L. Polzin, and J. M. Toole, Enhanced Diapycnal Mixing by Salt Fingers in the Thermocline of the Tropical Atlantic, *Science*, 308(5722), 685–688, doi:10.1126/science.1108678, 2005.
- Sundermeyer, M. A., J. R. Ledwell, N. S. Oakey, and B. J. W. Greenan, Stirring by small-scale vortices caused by patchy mixing, *J. Phys. Oceanogr.*, 35(7), 1245–1262, doi:<http://dx.doi.org/10.1175/JPO2713.1>, 2005.
- Proehl, J. A., D. R. Lynch, D. J. McGillicuddy, Jr., and J. R. Ledwell, Modeling turbulent dispersion on the North Flank of Georges Bank using Lagrangian particle methods, *Continental Shelf Res.*, 25(7-8), 875–900, doi:<http://dx.doi.org/10.1016/j.csr.2004.09.022>, 2005.
- Thurnherr, A. M., L. C. St. Laurent, K. G. Speer, J. M. Toole, and J. R. Ledwell, Mixing associated with sills in a canyon on the mid-ocean ridge flank, *J. Phys. Oceanogr.*, 35(8), 1370–1381, doi:<http://dx.doi.org/10.1175/JPO2773.1>, 2005.
- Ledwell, J. R., T. F. Duda, M. A. Sundermeyer, and H. E. Seim (2004), Mixing in a coastal environment: 1. A view from dye dispersion, *J. Geophys. Res.*, 109(C10), C10013, doi:10.1029/2003JC002194.
- Sundermeyer, M. A., and J. R. Ledwell, Lateral dispersion over the continental shelf: Analysis of dye-release experiments, *J. Geophys. Res.*, 106(C5), 9603–9622, doi:10.1029/2000JC900138, 2001.
- Lynch, D. R., et al., Real-time data assimilative modeling on Georges Bank, *Oceanography*, 14(1), 65–77, doi:<http://dx.doi.org/10.5670/oceanog.2001.50>, 2001.
- Ledwell, J. R., E. T. Montgomery, K. L. Polzin, L. C. St. Laurent, R. W. Schmitt, and J. M. Toole, Evidence for enhanced mixing over rough topography in the abyssal ocean, *Nature*, 403(6766), 179–182, doi:10.1038/35003164, 2000.
- Watson, A. J., and J. R. Ledwell, Oceanographic tracer release experiments using sulfur

- hexafluoride, *J. Geophys. Res.*, *105*(C6), 14325–14337, doi:10.1029/1999JC900272, 2000.
- Watson, A. J., et al., Mixing and convection in the Greenland Sea from a tracer-release experiment, *Nature*, *401*(6756), 902–904, doi:10.1038/44807, 1999.
- Ledwell, J. R., A. J. Watson, and C. S. Law, Mixing of a tracer in the pycnocline, *J. Geophys. Res.*, *103*(C10), 21499–21529, doi:10.1029/98JC01738, 1998.
- Polzin, K. L., J. M. Toole, J. R. Ledwell, and R.W. Schmitt, Spatial variability of turbulent mixing in the Abyssal Ocean, *Science*, *276*(5309), 93-96, doi:10.1126/science.276.5309.93. 1997.
- Ledwell, J. R., and B. M. Hickey, Evidence for enhanced boundary mixing in Santa Monica Basin, *J. Geophys. Res.*, *100*(C10), 20,665-20,680, 1995.
- Ledwell, J. R., and A. Bratkovich, A tracer study of mixing in Santa Cruz Basin, *J. Geophys. Res.*, *100*(C10), 20681-20704, doi:10.1029/95JC02164, 1995.
- Ledwell, J. R., A. J. Watson, and C. S. Law, Evidence for slow mixing across the pycnocline from an open-ocean tracer-release experiment, *Nature*, *364*(6439), 701-703, doi:10.1038/364701a, 1993.
- Ledwell, J. R. and A. J. Watson, The Santa Monica Basin Tracer Experiment: A study of diapycnal and isopycnal mixing, *J. Geophys. Res.*, *96*(C5), 8695-8718, doi:10.1029/91JC00102, 1991.
- Watson, A. J., J. R. Ledwell, and S. C. Sutherland, The Santa Monica Basin tracer experiment: Comparison of release methods and performance of perfluorodecalin and sulfur hexafluoride, *J. Geophys. Res.*, *96*(C5), 8719-8725, doi:10.1029/91JC00105, 1991.
- Ledwell, J. R., A. J. Watson, K. W. Doherty, and W. M. Berelson, Integrating samplers for the deep sea, *J. Geophys. Res.*, *96*(C5), 8727-8732, doi:10.1029/91JC00103, 1991.
- Wanninkhof, R., J. R. Ledwell, and A. J. Watson, Analysis of sulfur hexafluoride in seawater, *J. Geophys. Res.*, *96*(C5), 8733-8740, doi:10.1029/91JC00104, 1991.
- Ledwell, J. R., and A. J. Watson (1988), The use of deliberately injected tracers for the study of diapycnal mixing in the ocean, in *Small-Scale Turbulence and Mixing in the Ocean, Proceedings of the 19th International Liège Colloquium on Ocean Hydrodynamics*, Liège, Belgium, 4–8 May 1987, edited by J. C. J. Nihoul and B. M. Jamart, vol. 46, pp. 11–20, Elsevier, Amsterdam.
- Watson, A. J., J. R. Ledwell, D. J. Webb, and C. Wunsch (1988), Purposefully released tracers [and Discussion], *Phil. Trans. R. Soc. Lond. A*, *325*(1583), 189–200, <http://www.jstor.org/stable/38109>.

- Opdyke, B. N., G. Gust, and J. R. Ledwell, Mass transfer from smooth alabaster surfaces in turbulent flows, *Geophys. Res. Lett.*, *14*(11), 1131-1134, doi:10.1029/GL014i011p01131, 1987.
- Wanninkhof, R., J. R. Ledwell, W. S. Broecker, and M. Hamilton, Gas exchange on Mono Lake and Crowley Lake, California, *J. Geophys. Res.*, *92*(C13), 14567-14580, doi:10.1029/JC092iC13p14567, 1987.
- Watson, A. J., M. I. Liddicoat, and J. R. Ledwell, Perfluorodecalin and sulfur hexafluoride as purposeful marine tracers: some deployment and analysis techniques, *Deep-Sea Res. Part A*, *34*(1), 19-31, doi:http://dx.doi.org/10.1016/0198-0149(87)90118-X, 1987.
- Ledwell, J. R., A. J. Watson, and W. S. Broecker, A deliberate tracer experiment in Santa Monica Basin, *Nature*, *323*(6086), 322-324, doi:10.1038/323322a0, 1986.
- Broecker, W. S., J. R. Ledwell, T. Takahashi, R. Weiss, L. Merlivat, L. Memery, T.-H. Peng, B. Jahne, and K. O. Munnich, Isotopic versus micrometeorological ocean CO<sub>2</sub> fluxes: A serious conflict, *J. Geophys. Res.*, *91*(C9), 10517-10527, doi:10.1029/JC091iC09p10517, 1986.
- Smethie, W. M., Jr., T. Takahashi, D. W. Chipman, and J. R. Ledwell, Gas exchange and CO<sub>2</sub> flux in the Tropical Atlantic Ocean determined from <sup>222</sup>Rn and pCO<sub>2</sub> measurements, *J. Geophys. Res.*, *90*(C4), 7005-7022, doi:10.1029/JC090iC04p07005, 1985.
- Wanninkhof, R., J. R. Ledwell, and W. S. Broecker, Gas exchange-wind speed relation measured with sulfur hexafluoride on a lake, *Science*, *227*(4691), 1224-1226, abstract doi:10.1126/science.227.4691.1224, article, http://www.jstor.org/stable/1694215, 1985.

## Other Publications

- Gille, S. T., K. Speer, J. R. Ledwell, and A. C. Naveira Garabato, Mixing and Stirring in the Southern Ocean, *Eos Trans. AGU*, 88(39), 25 September 2007, 382-383, 2007.
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