

SAMAR P. KHATIWALA

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Present Position

Lamont Associate Research Professor (Senior Staff), Lamont-Doherty Earth Observatory, Columbia University.

Education

COLUMBIA UNIVERSITY New York, NY
September 1992–November 1999

2000 Ph.D. in Earth and Environmental Sciences.

Title: A tracer and modeling study of the Labrador Sea.

Advisors: Profs. Martin Visbeck and Peter Schlosser.

1998 M. Phil. in Earth and Environmental Sciences.

Title: Freshwater sources to the coastal ocean off northeastern North America.

Advisor: Prof. Richard G. Fairbanks.

INDIAN INSTITUTE OF TECHNOLOGY Bombay, India
August 1990–May 1992

1992 M. Sc. in Applied Geophysics.

ST. XAVIER'S COLLEGE Bombay, India
August 1987–May 1990

1990 B. Sc. in Geology and Chemistry.

Positions/Employment

July 2010–Present: Lamont Associate Research Professor (Senior Staff), Lamont-Doherty Earth Observatory, Columbia University.

March–June, 2010: Doherty Research Scientist, Division of Geochemistry, Lamont-Doherty Earth Observatory, Columbia University.

August 2009–March 2010: Associate Professor, School of Earth and Atmospheric Science, Georgia Institute of Technology.

2004–2010: Doherty Associate Research Scientist, Division of Ocean and Climate Physics, Lamont-Doherty Earth Observatory, Columbia University.

2002–2004: Post-Doctoral Research Scientist, Lamont-Doherty Earth Observatory, Columbia University. Post-doc advisor: Mark Cane.

1999–2002: William Z. Leavitt Post-Doctoral Fellow, Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology. Post-doc advisor: Carl Wunsch.

Visiting Appointments

September, 2009–July, 2010, Visiting Scientist in Trace Gas Research Group, Center for Atmospheric and Oceanic Studies, Tohoku University, Sendai, Japan.

May–June 2007, Visiting Scientist at IFM-GEOMAR/University of Kiel, Kiel, Germany.

Awards

William Z. Leavitt Career Development Fellowship, Massachusetts Institute of Technology, 1999–2002.

Heezen Prize for Excellence in Academics and Research, Columbia University, 1999.

Faculty Fellow, Columbia University, 1992–1999.

Memberships American Geophysical Union; Society of Industrial and Applied Mathematics.

Publications

Published and submitted articles

[1] Wang, S., J. K. Moore, F. Primeau, and **S. Khatiwala** (2011). Simulation of anthropogenic CO₂ uptake in the CCSM3.1 ocean circulation-biogeochemical model: Comparison with data-based estimates. *Submitted to Biogeoscience*.

[2] **Khatiwala, S.**, F. Primeau, and M. Holzer (2011). Ventilation of the deep ocean constrained with tracer observations and implications for radiocarbon estimates of ideal mean age. submitted to *Earth Planet. Sci. Lett.*

[3] Sabine, C. L., R. A. Feely, R. Wanninkhof, T. Takahashi, **S. Khatiwala** and G.-H. Park (2011). The Global Carbon Cycle, in *State of the Climate in 2010*, Accepted for publication in *Bull. Amer. Meteor. Soc.*.

[4] Kriest, I., A. Oschlies, and **S. Khatiwala** (2011). Sensitivity analysis of simple global biogeochemical models. *Submitted to Glob. Biogeochem. Cycles*.

[5] Sabine, C. L. et al. (2011). Ocean Chemistry Changes, in *Chapter 3: Ocean Observations, IPCC 5th Assessment Report*, submitted.

[6] Feely, R. et al. (2011). The Ocean, in *Chapter 6: Carbon and Other Biogeochemical Cycles, IPCC 5th Assessment Report*, submitted.

- [7] Nicholson, D. P., S. R. Emerson, **S. Khatiwala**, and R. C. Hamme (2011). An inverse approach to estimate bubble-mediated air-sea gas flux from inert gas measurements. *Proc. of the 6th International Symposium on Gas Transfer at Water Surfaces*, Kyoto University Press, Kyoto, Japan.
- [8] Kriest, I., **S. Khatiwala**, and A. Oschlies (2010). Assessment of simple global marine biogeochemical models of increasing complexity. *Prog. Oceanogr.*, **86**, doi:10.1016/j.pocean.2010.05.002.
- [9] Sabine, C. L., R. A. Feely, R. Wanninkhof, T. Takahashi, **S. Khatiwala** and G.-H. Park (2010). The Global Carbon Cycle, in *State of the Climate in 2009*, *Bull. Amer. Meteor. Soc.*, **91** (6), S71-S75.
- [10] Carlson, C. A., D. A. Hansell, N. B. Nelson, D. A. Siegel, W. M. Smethie, Jr., **S. Khatiwala**, M. M. Meyers, and E. Halewood (2010). Dissolved organic carbon export and subsequent remineralization in the mesopelagic and bathypelagic realms of the North Atlantic basin. *Deep Sea Res. II*, **57**, doi:10.1016/j.dsr2.2010.02.013.
- [11] Holzer, M., F. Primeau, W. Smethie, and **S. Khatiwala** (2010). Where and how long ago was water in the western North Atlantic ventilated? Maximum-entropy inversions of bottle data from WOCE line A20. *J. Geophys. Res.*, **115**, doi:10.1029/2009JC005750.
- [12] **Khatiwala, S.**, F. Primeau, and T. M. Hall (2009). Reconstruction of the history of anthropogenic CO₂ concentrations in the ocean. *Nature*, **462**, doi:10.1038/nature08526. (See associated “Making the Paper” story in the same issue (<http://www.nature.com/nature/journal/v462/n7271/full/7271250a.html>), and media coverage in *The New York Times* (http://www.nytimes.com/2009/11/19/science/earth/19oceans.html?_r=1&hpw), *Time Magazine* (<http://www.time.com/time/health/article/0,8599,1940391,00.html>), *National Geographic* (<http://news.nationalgeographic.com/news/2009/11/091118-oceans-carbon-sink-global-warming.html>), *NPR* (<http://www.loe.org/shows/segments.htm?programID=09-P13-00047&segmentID=1>), and *German public radio* (<http://www.dradio.de/dlf/sendungen/forschak/1072956/>).
- [13] Siddall, M., **S. Khatiwala**, T. van de Flierdt, K. Jones, S. Goldstein, S. Hemming, and R. F. Anderson (2008). Towards explaining the Nd paradox using reversible scavenging in an ocean general circulation model. *Earth Planet. Sci. Lett.*, **274**, 448–461.
- [14] Jones, K.¹, **S. Khatiwala**, T. van de Flierdt, S. Hemming, and S. Goldstein (2008). Modeling the distribution of Nd isotopes in the oceans using an offline ocean general circulation model. *Earth Planet. Sci. Lett.*, **272**, 619–619.

¹Student is first author.

- [15] **Khatiwala, S.** (2008). Fast spin up of ocean biogeochemical models using matrix-free Newton-Krylov. *Ocean Modelling*, **23**, 121–129.
- [16] Merlis, T.¹ and **S. Khatiwala** (2008). Fast dynamical spin-up of ocean general circulation models using Newton-Krylov methods. *Ocean Modelling*, **21**, 97–105.
- [17] **Khatiwala, S.** (2007). A computational framework for simulation of biogeochemical tracers in the ocean. *Glob. Biogeochem. Cycles*, **21**, GB3001, doi:10.1029/2007GB002923.
- [18] Nelson, N. B., D. A. Siegel, C. A. Carlson, C. Swan, W. M. Smethie, and **S. Khatiwala** (2007). Hydrography of chromophoric dissolved organic matter in the North Atlantic, *Deep Sea Res. I*, **54**, 710–731.
- [19] Terenzi, F.¹, T. M. Hall, **S. Khatiwala**, C. B. Rodehacke, and D. A. LeBel (2007). Uptake of natural and anthropogenic carbon by the Labrador Sea. *Geophys. Res. Lett.*, **34**, doi:10.1029/2006GL028543.
- [20] **Khatiwala, S.**, M. Visbeck, and M. Cane (2005). Accelerated simulation of passive tracers in ocean circulation models. *Ocean Modelling*, **9**, 51–69.
- [21] Hall, T. M., D. W. Waugh, T. W. N. Haine, P. E. Robbins, and **S. Khatiwala** (2004). Estimates of anthropogenic carbon in the Indian Ocean with allowance for mixing and time-varying air-sea CO₂ disequilibrium. *Global Biogeochem. Cycles*, **18**, doi:10.1029/2003GB002120.
- [22] **Khatiwala, S.** (2003). Generation of internal tides in an ocean of finite depth: analytical and numerical calculations. *Deep Sea Res. I*, **50**, 3–21.
- [23] Schörghofer, N., O. Aharonson, and **S. Khatiwala** (2002). Slope streaks on Mars: Correlations with surface properties and the potential role of water. *Geophys. Res. Letts.*, **29**, doi:10.1029/2002GL015889.
- [24] **Khatiwala, S.**, P. Schlosser, and M. Visbeck (2002). Rates and mechanisms of water mass transformation in the Labrador Sea as inferred from tracer observations. *J. Phys. Oceanogr.*, **32**, 666–686.
- [25] Schlosser, P., R. Newton, B. Ekwurzel, **S. Khatiwala**, R. Mortlock, and R. Fairbanks (2002). Decrease of river runoff in the upper waters of the Eurasian Basin, Arctic Ocean, between 1991 and 1996: Evidence from $\delta^{18}\text{O}$ data. *Geophys. Res. Letts.*, **29**, doi:10.1029/2001GL013135.
- [26] **Khatiwala, S.**, B. E. Shaw, and M. A. Cane (2001). Enhanced sensitivity of persistent events to weak forcing in dynamical and stochastic systems: Implications for climate change. *Geophys. Res. Letts.*, **28**, 2633–2636.

¹Student is first author.

- [27] **Khatiwala, S.**, M. Visbeck, and P. Schlosser (2001). Age tracers in an ocean GCM. *Deep-Sea Res. I*, **48**, 1423–1441.
- [28] **Khatiwala, S.** and M. Visbeck (2000). An estimate of the eddy-induced circulation in the Labrador Sea. *Geophys. Res. Letts.*, **27**, 2277–2280.
- [29] Schlosser, P., B. Ekwurzel, **S. Khatiwala**, R. Newton, W. Maslowski, and S. Pfirman (2000). Tracer studies of the Arctic freshwater budget. *In: Freshwater balance of the Arctic Ocean*, NATO, ed. E. L. Lewis.
- [30] Schlosser, P., R. Bayer, G. Bönisch, L. Cooper, B. Ekwurzel, W. J. Jenkins, **S. Khatiwala**, S. Pfirman, and W. M. Smethie (1999). Pathways and mean residence times of dissolved pollutants in the ocean derived from transient tracers and stable isotopes. *Science of the Total Environment*, **237/238**, 15–30.
- [31] **Khatiwala, S.**, R. G. Fairbanks, and R. Houghton (1999). Freshwater sources to the coastal ocean off northeastern North America: Evidence from $H_2^{18}O/H_2^{16}O$. *J. Geophys. Res.*, **104**, 18241–18255.
- [32] Weppernig, R., P. Schlosser, **S. Khatiwala**, and R. G. Fairbanks (1996). Isotope data from Ice Station Weddell: Implications for deep water formation in the Weddell Sea. *J. Geophys. Res.*, **101**, 25723–25739.

Manuscripts in preparation

- [33] **Khatiwala, S.**, M. Holzer, and F. Primeau (2011). Ventilation and re-ventilation time scales and pathways for water and anthropogenic CO_2 in the ocean.
- [34] Wang, D.¹, **S. Khatiwala**, and M. A. Cane (2011). Present and future source regions and transit time distributions of Pacific equatorial thermocline waters.
- [35] **Khatiwala, S.** An iterative method for the fast dynamical spin-up of ocean general circulation models.
- [36] **Khatiwala, S.** Ventilation and re-exposure pathways and time scales of oxygen minimum zone waters and their response to global warming.
- [37] **Khatiwala, S.** Trends in Southern Ocean uptake and storage of anthropogenic CO_2 over the industrial era reconstructed from tracer observations.
- [38] **Khatiwala, S.** A note on the computation of adjoint sensitivities of numerical models in equilibrium.
- [39] **Khatiwala, S.** Constraining projections of future ocean anthropogenic CO_2 uptake and changes in chemistry with past observations.

Pending Proposals

NSF EAGER Toward a mechanistic understanding of the ocean biological pump:

¹Student is first author.

exploiting GPU hardware for ocean biogeochemical modeling, \$200,000. (Lead PI; with Tinna Jokulsdottir and Norbert Schörghofer.) (Submitted 2011.)

Funded Proposals

NSF OCE-1129973 Collaborative Research: An Inverse and Forward Global Modeling Synthesis of Noble Gases to Better Quantify Biogeochemical Cycles, \$162,457. (Co-PI; with David Nicholson, WHOI.) (Funded 2011.)

NSF OCE-1060804 Constraining the Past and Future Ocean Sink of Anthropogenic Carbon with Observations, \$467,174. (Funded 2011.)

Teragrid OCE-080002 Simulating changes in subtropical-tropical thermocline water mass exchange under global warming. NSF Teragrid Medium Resource Allocations Committee (MRAC) for 270,000 SUs of supercomputer time on TACC Ranger.

Lamont Climate Center Simulating changes in subtropical-tropical water mass exchange under global warming using the transport matrix method, \$7,800. Seed money for new research project. (Funded 2009.)

NSF OCE-0824635 Collaborative Research: Fast Spin Up of Ocean General Circulation Models Using Newton-Krylov Methods, \$361,750. (Lead PI; with Carl Wunsch and Patrick Heimbach, MIT.) (Funded 2008.)

Teragrid OCE-080001 Computation of forward and adjoint Green functions in the ocean using an offline tracer model. NSF Teragrid Medium Resource Allocations Committee (MRAC) for 550,000 SUs of supercomputer time on TACC Ranger.

Teragrid OCE-090001 Simulating changes in the tropical-subtropical water mass exchange under global warming using the adjoint transit time distribution method. NSF Teragrid Development Allocations Committee (DAC) for 30,000 SUs of supercomputer time on TACC Lonestar.

NSF OCE-0727229 Collaborative Research: New Diagnostics of Water-Mass Ventilation Estimated from Tracer Data, \$413,917. (Co-PI; with Mark Holzer, NASA/GISS.) (Funded 2007.)

NSF OCE-0623611 Collaborative Research: Understanding Tidal Resonances in the Present-Day and Ice-Age Oceans, \$200,432. (Lead PI; with Brian Arbic, U. Texas.) (Funded 2006.)

Teragrid OCE070000T Global Estimates of Past and Future Uptake of Anthropogenic Carbon by the Ocean. NSF Teragrid Development Allocations Committee (DAC) for 30,000 SUs of supercomputer time on TACC Lonestar.

NSF OCE-0623366 Collaborative Research: Global Estimates of Past and Future Uptake of Anthropogenic Carbon by the Ocean, \$384,173. (Co-PI; with Timothy Hall, NASA/GISS.) (Funded 2006.)

Lamont Climate Center Improved Parametrization of Gas Exchange in Global Ocean Models, \$5,500. Funds to support undergraduate research. (2006.)

Columbia University Initiatives in Science and Engineering Newton-Krylov Methods for Fast Dynamical Spin up of Ocean Climate Models, \$55,098. (Lead PI; with David Keyes, APAM, and Mark Cane, LDEO.) Seed money for new research project. (2005.)

Lamont Climate Center A Monte Carlo Approach to Climate Modeling, \$6,000. Funds to support undergraduate research. (2005.)

NSF OCE-0449703 Accelerated Dynamical Spin Up of Ocean General Circulation Models, \$80,397 (Funded 2004.)

Lamont Climate Center The Glacial Ocean Circulation in a Coupled Climate Model: Comparison with Paleoproxy Records, \$5,800. Funds to support undergraduate research. (2004.)

NOAA Establishment of the Cooperative Institute for Climate Applications and Research. (Co-PI; with Yochanan Kushnir, LDEO.) (Funded 2003.)

NSF OCE-0336808 Collaborative Research: Interaction of Eddies with Mixed-layers, \$99,330. (Co-PI; with Raffaele Ferrari, MIT.) (Funded 2003.)

NSF ATM-0233853 Sensitivity of Persistence Characteristics of Atmospheric Weather Regimes, \$459,522. (Lead PI; with Lorenzo Polvani and Mark Cane.) (Funded 2003.)

Lamont Climate Center Accelerated Simulation of Passive Tracers in Ocean Circulation Models, \$3,400. Funds to support undergraduate research. (2003.)

Abstracts

Tanhua, T., **S. Khatiwala**, C. L. Sabine (2011). Carbon changes in the interior ocean. Joint SOLAS-IMBER-IOCCP Meeting on The Ocean Carbon Cycle at a Time of Change: Synthesis and Vulnerabilities, UNESCO, Paris.

Oschlies, A., I. Kriest, O. Duteil, W. Koeve, and **S. Khatiwala** (2011). Assessing the marine biogeochemistry component of global ocean carbon models. EGU General Assembly, Vienna.

Duteil, O., I. Kriest, **S. Khatiwala**, and A. Oschlies (2011). Coupling of a complex biogeochemical model with the Transport Matrix Method : quantification of the impact of margin iron input on the ecosystem. EGU General Assembly, Vienna.

Khatiwala, S., F. Primeau, and M. Holzer (2010). Role of ocean ventilation in setting regional patterns of uptake and storage of anthropogenic CO₂: insights from inverse estimates of the ocean's transport Green function. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Kriest, I., A. Oschlies, and **S. Khatiwala** (2010). Sensitivity of global biogeochemical models to the parameterization of organic matter production and export:

rem mineralization length scale versus production parameters. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Carlson, C. A., D. A. Hansell, N. B. Nelson, D. A. Siegel, W. M. Smethie, and **S. Khatiwala** (2010). Dissolved organic carbon distribution, export and subsequent remineralization in the mesopelagic and bathypelagic realms of the North Atlantic basin. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Landers, J. P.¹, F. Terenzi, and **S. Khatiwala** (2010). Transient response of the CO₂ airborne fraction to fluctuations in emissions: the role of climate-carbon feedbacks versus emissions growth rate. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Khatiwala, S. (2010). Mapping time-varying distribution of anthropogenic carbon. Invited talk at the COCOS-RECCAP Workshop on “Regional Carbon Cycle Assessment on Land and Oceans”, Viterbo, Italy.

Khatiwala, S. (2010). Reconstruction of the ocean sink of anthropogenic carbon over the Industrial era. Plenary speaker at the 3rd Bi-annual Symposium Future Ocean, University of Kiel, Kiel.

Kriest, I., **S. Khatiwala**, and A. Oschlies (2010). The sensitivity of global biogeochemical models to different remineralisation length scales and production parameters: some attempts to constrain parameterisations of biogeochemistry. 3rd Bi-annual Symposium Future Ocean, University of Kiel, Kiel, September 2010.

Khatiwala, S., F. Primeau, and T. Hall (2010). Mapping the time-varying distribution of anthropogenic carbon in the ocean with Green functions. Invited talk at the AGU Ocean Sciences Meeting, Portland.

Khatiwala, S. and T. Arsouze (2010). Ventilation and reexposure pathways and time scales of oxygen minimum zone waters and their response to global warming. AGU Ocean Sciences Meeting, Portland.

Terenzi, F.¹ and **S. Khatiwala** (2010). Trends in Southern Ocean uptake and storage of anthropogenic CO₂ over the industrial era reconstructed from tracer observations. AGU Ocean Sciences Meeting, Portland.

Wang, D.¹, **S. Khatiwala**, and M. A. Cane (2010). Source regions and transit-time distributions of Pacific equatorial thermocline waters: consequences of a warmer climate. AGU Ocean Sciences Meeting, Portland.

Khatiwala, S., F. Primeau, and T. Hall (2009). Reconstruction of the history of anthropogenic CO₂ in the ocean over the industrial era. 8th International Carbon Dioxide Conference, Jena, Germany.

Kriest, I., A. Oschlies, and **S. Khatiwala** (2009). Parameterization of export, sinking and remineralization and its effect on simulated tracers in large scale models

¹Student is first author.

of marine biogeochemistry. AGU Chapman Conference on the Biological Carbon Pump of the Oceans, Brockenhurst, England.

Oschlies, A., I. Kriest, and **S. Khatiwala** (2009). Assessing the marine biogeochemistry component of coupled carbon-climate models. MOCA-09 Joint Assembly, Montréal.

Khatiwala, S. (2008). An observationally-based reconstruction of the 3-dimensional, time-dependent history of anthropogenic carbon in the ocean and its implications for the global carbon cycle. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Eckerle, K.¹ and **S. Khatiwala** (2008). Role of eddies in controlling the uptake of anthropogenic carbon in the Southern Ocean and implications for recent claims of a decline in the ocean carbon sink. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Wang, D.¹, M. Cane, **S. Khatiwala**, and D. Chen (2008). Changes of the shallow Pacific Meridional Overturning Circulation under global warming. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Terenzi, F.¹, **S. Khatiwala**, and T. Hall (2008). Modeling the atmospheric airborne fraction in a simple carbon cycle model. (Ocean Carbon and Biogeochemistry Workshop, Woods Hole.)

Kriest, I., A. Oschlies, and **S. Khatiwala** (2008). Development and assessment of global marine biogeochemical models of varying complexity. 4th Scientific Computing Conference (Theme: “Data Assimilation in Geosciences”) of the Institut für Informatik, University of Kiel, Kiel.

Kriest, I., A. Oschlies, and **S. Khatiwala** (2008). Development and assessment of a model for global ecosystems. MERSEA Plenary Meeting, Institut Oceanographique, Paris.

Khatiwala, S. (2008). Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions. Invited talk in the session on Ocean Tracers and Anthropogenic CO₂ at the EGU General Assembly, Vienna.

Khatiwala, S. (2008). Fast spinup of seasonally-forced global ocean biogeochemical models using matrix-free Newton-Krylov. *EOS Trans. AGU*. (AGU Ocean Sciences Meeting, Orlando.)

Fine, R. A., W. M. Smethie, J. Happell, **S. Khatiwala**, and A. Macdonald (2008). Beyond the DWBC, NADW pathways. *EOS Trans. AGU*. (AGU Ocean Sciences Meeting, Orlando.)

¹Student is first author.

Henry-Edwards, A., J. Karstensen, **S. Khatiwala**, and B. Schneider (2008). A Method to determine individual water mass carbon uptakes using an inverse mixing analysis. *EOS Trans. AGU*. (AGU Ocean Sciences Meeting, Orlando.)

Jones, K.¹, **S. Khatiwala**, S. Goldstein, S. Hemming, and T. van de Flierdt (2007). Modeling the distribution of Nd isotopes in the oceans using an offline ocean general circulation model. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Khatiwala, S. (2007). Newton-Krylov Methods for Fast Dynamical Spinup of Ocean General Circulation Models. Invited talk for the “Minisymposium on Implicit and Adjoint Techniques in Ocean Modeling”, SIAM Conference on Mathematical and Computational Issues in the Geosciences, Santa Fe.

Khatiwala, S. (2006). A Computational Framework for Simulation of Biogeochemical Tracers in the Ocean. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Terenzi, F.¹, T. Hall, **S. Khatiwala**, and D. LeBel (2006). Uptake of Natural and Anthropogenic Carbon by the Labrador Sea Water and the Subtropical Mode Water in the North Atlantic. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Fine, R. A., W. M. Smethie, **S. Khatiwala**, A. M. Macdonald, J. Happell, T. Tonhua, and J. L. Bullister (2006). Beyond the DWBC: NADW interior pathways and their variability. (Rapid Climate Change, International Science Conference, Birmingham, U.K.)

Merlis, T.¹, **S. Khatiwala**, and D. E. Keyes (2006). Jacobian-Free Newton-Krylov for Steady-States and Limit-Cycles of Time-Steppers. (SIAM Annual Meeting, Boston.)

Merlis, T.¹ and **S. Khatiwala** (2006). Fast Dynamical Spin up of Ocean General Circulation Models. (AGU Spring Meeting, Baltimore.)

Terenzi, F.¹, T. Hall, **S. Khatiwala**, and D. LeBel (2006). Inventory and uptake of anthropogenic carbon by Labrador Sea Water. (EGU General Assembly, Vienna.)

Khatiwala, S., T. Hall, and C. Rodehacke (2006). A Systematic Evaluation of the Transit-Time Distribution Approach to Inferring the Oceanic Uptake and Inventory of Anthropogenic Carbon and the Impact of SF₆ and ³⁹Ar Observations. *EOS Trans. AGU*. (AGU Ocean Sciences Meeting, Honolulu.)

Rodehacke, C., T. Hall, and **S. Khatiwala** (2006). Comparison of Anthropogenic Carbon Inference Techniques: Transit Time Distributions and Classical Back-Calculation Techniques. *EOS Trans. AGU*. (AGU Ocean Sciences Meeting, Honolulu.)

Khatiwala, S., M. Visbeck, and D. Olbers (2003). Observational estimates of the eddy-diffusivity in the Antarctic Circumpolar Current. (CLIVAR Climate Process

¹Student is first author.

Modeling Team meeting on eddy-mixed layer interactions, National Center for Atmospheric Research, Boulder.)

Visbeck, M. and **S. Khatiwala** (2003). Reynolds stress observations and model simulations in a partially mixed estuary using a bottom mounted ADCP. *EOS Trans. AGU*. (EGS-AGU-EUG, Nice.)

Khatiwala, S. and M. Visbeck (2003). A novel strategy for accelerated simulation of passive tracers in ocean circulation models. *EOS Trans. AGU*. (EGS-AGU-EUG, Nice.)

Khatiwala, S. (2003). Sensitivity of atmospheric flow regimes to anthropogenic forcing: Insights from an intermediate atmospheric model. *EOS Trans. AGU*. (EGS-AGU-EUG, Nice.)

Aharonson, O., N. Schörghofer, M. I. Richardson, and **S. Khatiwala** (2003). Morphological and thermo-physical properties of slope streaks. (Sixth International Conference on Mars, Pasadena.)

Schörghofer, N. and **S. Khatiwala** (2003). Tidal conversion by rough topography. (Annual Meeting of the American Physical Society, Austin.)

Perlwitz, J., **S. Khatiwala**, and N. Harnik (2002). The Statistical Relationship Between the Stratospheric NAM and the Tropospheric Zonal Mean and Wave Fields. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Aharonson, O., N. Schörghofer, **S. Khatiwala**, and M. I. Richardson, (2002). Morphologic, topographic, and thermal analysis of slope streaks on Mars. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Khatiwala, S., P. Schlosser, and M. Visbeck (2002). Rates and mechanisms of water mass transformation in the Labrador Sea: inferences from tracer observations. (Plenary Meeting of the World Ocean Circulation Experiment, San Antonio.)

Aharonson, O., **S. Khatiwala**, and N. Schörghofer (2002). Evidence for a water phase-transition at low latitudes on the surface of present-day Mars. *EOS Trans. AGU*. (AGU Spring Meeting, Washington, DC.)

Khatiwala, S. (2002). Generation of Internal Tides in the Ocean. *EOS Trans. AGU*. (AGU Ocean Sciences Meeting, Honolulu.)

Khatiwala, S., B. Shaw, and M. Cane (2001). Enhanced sensitivity of persistent events to weak forcing in dynamical and stochastic systems: implications for climate change. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Khatiwala, S., P. Schlosser, and M. Visbeck (2001). Rates and mechanisms of water mass transformation in the Labrador Sea: inferences from tracer observations. (U.S. CLIVAR Atlantic Meeting, Boulder.)

Schlosser, P., W. M. Smethie, M. Mensch, G. Bönisch, R. Bayer, M. Frank, B. Ekurzel, and S. **Khatiwala** (2000). Distribution of tritium/ ^3He and $\delta^{18}\text{O}$ in the Arctic Ocean: spreading times of Atlantic water and intermediate water and distribution of freshwater from river-runoff, sea-ice meltwater, and Pacific inflow. (EGS, Nice.)

Khatiwala, S. and P. Schlosser (1999). Tracer Observations in the Labrador Sea. (North Atlantic Meeting of the World Ocean Circulation Experiment, Kiel.)

Khatiwala, S., P. Schlosser, R. G. Fairbanks, and R. Mortlock (1999). Freshwater balance of the Labrador Sea. *IUGG Abstracts*. (General Assembly, Birmingham, IUGG/IAPSO symposium on stable isotopes and trace substances.)

Khatiwala, S. Age Tracers in an Ocean General Circulation Model (1998). (Conference on Age Tracers in the Atmosphere and Ocean, Massachusetts Institute of Technology, Cambridge.)

Schlosser, P., **S. Khatiwala**, S. Pfirman, B. Ekurzel, R. G. Fairbanks, R. Mortlock, R. Bayer, L. Cooper, and R. MacDonald (1998). Application of the $\text{H}_2^{18}\text{O}/\text{H}_2^{16}\text{O}$ ratio in studies of the Arctic freshwater balance. *EOS Trans. AGU*. (AGU Fall Meeting, San Francisco.)

Weppernig, R., P. Schlosser, R. G. Fairbanks, and **S. Khatiwala** (1997). Deep Water formation in the Weddell Sea: implications from Ice Station Weddell tracer observations. *IAPSO Proceedings*.

Schlosser, P., R. Bayer, G. Bönisch, B. Ekurzel, M. Frank, **S. Khatiwala**, W. Maslowski, R. Newton, and W. M. Smethie (1997). New insights into the circulation and freshwater balance of the Arctic Ocean derived from multi-tracer data sets. *Proceedings of the ACSYS Conference "Polar processes and global climate"*. (Rosario, Orcas Islands, Washington.)

Invited Talks Massachusetts Institute of Technology, Oceanography Seminar, March 2011. Constraining ocean ventilation time scales with tracer observations: implications for anthropogenic CO_2 uptake and radiocarbon ages.

Woods Hole Oceanographic Institution, Physical Oceanography Seminar, January 2011. Constraining ocean ventilation time scales with tracer observations: implications for anthropogenic CO_2 uptake and radiocarbon ages.

Plenary speaker at the 3rd Bi-annual Symposium Future Ocean, University of Kiel, Kiel, September 2010. Reconstruction of the ocean sink of anthropogenic carbon over the Industrial era

Invited talk at the COCOS-RECCAP Workshop on "Regional Carbon Cycle Assessment on Land and Oceans", Viterbo, Italy, October 2010. Mapping time-varying distribution of anthropogenic carbon.

Invited talk at the AGU Ocean Sciences Meeting, Portland, February 2010. Mapping the time-varying distribution of anthropogenic carbon in the ocean with Green functions.

Frontier Research Center for Global Change, Yokohama, Japan, December 2009. Understanding recent changes in the Southern Ocean sink of anthropogenic CO₂.

Center for Atmospheric and Oceanic Studies, Tohoku University, Sendai, Japan, December 2009. The ocean sink of anthropogenic CO₂.

National Oceanography Center, University of Southampton, Southampton, May 2009. Data assimilation and parameter optimization in global ocean biogeochemical models.

University of Oxford, Oxford, Department of Earth Sciences, May 2009. Toward a prognostic model of Nd isotopes in the ocean.

School of Earth and Atmospheric Science, Georgia Institute of Technology, March 2009. The ocean sink of anthropogenic CO₂.

Nicholas School of the Environment, Division of Earth and Ocean Sciences, Duke University, March 2009. The ocean sink of anthropogenic CO₂.

Department of Oceanic and Atmospheric Sciences, University of Wisconsin, January 2009. An observationally-based reconstruction of the 3-dimensional, time-dependent history of anthropogenic carbon in the ocean and its implications for the global carbon cycle.

Frontier Research Center for Global Change, Yokohama, Japan, January 2009. Fast spin up of global ocean biogeochemical models using matrix-free Newton-Krylov

University of California, Los Angeles, Atmospheric Science Seminar, February 2008. Inverse modeling of ocean ventilation and anthropogenic CO₂ uptake.

Invited speaker at the MARUM workshop on “Reconstruction of the Glacial Deep Ocean Circulation”, University of Bremen, Bremen, November 2008.

Plenary speaker at the Ocean Carbon and Biogeochemistry Workshop, Woods Hole, July 2008. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions.

Invited talk at the 4th Scientific Computing Conference (Theme: “Data Assimilation in Geosciences”) of the Institut für Informatik, University of Kiel, Kiel, June 2008. Observational constraints on parameterizations of particulate organic matter export and remineralization in global biogeochemical models.

Invited talk in the session on Ocean Tracers and Anthropogenic CO₂ at the EGU General Assembly, Vienna, April 2008. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions.

University of California, Los Angeles, Atmospheric Science Seminar, February 2008. Inverse modeling of ocean ventilation and anthropogenic CO₂ uptake.

University of California, Santa Cruz, Ocean Science Seminar, February 2008. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions.

Massachusetts Institute of Technology, Oceanography Seminar, February 2008. Fast spin up of global ocean biogeochemical models using matrix-free Newton-Krylov.

Woods Hole Oceanographic Institution, Marine Chemistry and Geochemistry Seminar, February 2008. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions.

GEOTRACES Data-Model Synergy Workshop, Delmenhorst, September 2007. Fast offline forward and adjoint modeling of ocean biogeochemical and paleoceanographic tracers using the transport matrix method.

ETH Zurich, Environmental Physics Group Seminar, Institut für Biogeochemie und Schadstoffdynamik, September 2007. A computational framework for simulation of biogeochemical tracers in the ocean.

Invited talk at the “Minisymposium on Implicit and Adjoint Techniques in Ocean Modeling”, SIAM Conference on Mathematical and Computational Issues in the Geosciences, Santa Fe, March 2007. Newton-Krylov Methods for Fast Dynamical Spinup of Ocean General Circulation Models.

Harvard University, Climate Seminar, April 2007. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions

University of Colorado, Boulder/CIRES, March 2007. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions

School of Earth and Environmental Sciences, Queens College/CUNY, March 2007. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions

Lamont-Doherty Earth Observatory, Geochemistry Seminar, Feb 2007. Global ocean uptake and storage of anthropogenic carbon estimated using transit-time distributions

International Research Institute for Climate and Society, Columbia University, New York, November 2006. Newton-Krylov Methods for Fast Dynamical Spinup of Ocean General Circulation Models

Alfred Wegener Institute für Polar-und Meeresforschung, Bremerhaven, Germany, October 2006. Anthropogenic Carbon Uptake by the Ocean Estimated Using Transit-Time Distributions.

Max-Planck Institut für Meteorologie and the University of Hamburg, Germany, October 2006. Anthropogenic Carbon Uptake by the Ocean Estimated Using Transit-Time Distributions.

IFM-GEOMAR, Universität Kiel, Germany, October 2006. Anthropogenic Carbon Uptake by the Ocean Estimated Using Transit-Time Distributions.

Ecosystem Change Research Program Seminar Series, Frontier Research Center for Global Change, Yokohama, Japan, May 2006. Anthropogenic Carbon Uptake by the Ocean Estimated Using Transit-Time Distributions.

NASA Goddard Institute for Space Studies, New York, April 2006. Fast Dynamical Spinup of Ocean General Circulation Models

Lamont-Doherty Earth Observatory, Climate and Physical Oceanography Seminar, April 2006. Anthropogenic Carbon Uptake by the Ocean Estimated Using Transit-Time Distributions.

Columbia University, Applied Physics Research Conference, October 2005. Newton-Krylov Methods for Fast Dynamical Equilibration of Ocean Climate Models.

Courant Institute for Mathematical Sciences, NYU, Colloquium in Atmosphere-Ocean Science, March 2004. A novel strategy for accelerated simulation of passive tracers in ocean circulation models.

Lamont-Doherty Earth Observatory, Climate and Physical Oceanography Seminar, March 2004. A novel strategy for accelerated simulation of passive tracers in ocean circulation models.

Columbia University, IGERT Applied Mathematics Seminar Series, March 2004. Accelerated simulation of geochemical tracers in ocean circulation models.

NASA Goddard Institute for Space Studies, New York, January 2004. Geochemical tracer simulation in ocean circulation models.

Geophysical Fluid Dynamics Laboratory/Princeton University, May 2003. A novel strategy for accelerated simulation of passive tracers in ocean circulation models.

Massachusetts Institute of Technology, Oceanography and Climate Seminar, April 2003. A novel strategy for accelerated simulation of passive tracers in ocean circulation models.

Columbia University, IGERT Applied Mathematics Seminar Series, February 2003. Martian geomorphology, slope-streaks, and the potential role of water.

Johns Hopkins University, Center for Environmental and Applied Fluid Mechanics, February 2003. Generation of internal tides in a fluid of finite depth: Analytical and numerical calculations.

Columbia University, Applied Physics Research Conference, November 2002. Sensitivity of atmospheric flow regimes to anthropogenic forcing: Insights from simple dynamical and stochastic systems.

Lamont-Doherty Earth Observatory, Climate and Physical Oceanography Seminar, September 2002. Generation of internal tides in a fluid of finite depth: Analytical and numerical calculations.

Woods Hole Oceanographic Institution, Physical Oceanography Seminar, March 2002. Generation of internal tides in the ocean.

Massachusetts Institute of Technology, Oceanography and Climate Seminar, February 2002. Internal tide generation in a finite depth ocean.

University of Chicago, Department of the Geosciences, January 2002, Sensitivity of atmospheric flow regimes to anthropogenic forcing: Insights from simple dynamical and stochastic systems.

Geophysical Fluid Dynamics Laboratory/Princeton University, November 2001. Age tracers and transit-time distributions in the ocean.

Woods Hole Oceanographic Institution, Physical Oceanography Seminar, June 2001. Rates and mechanisms of water mass transformation in the Labrador Sea as inferred from tracer observations.

Workshops

MARUM workshop on “Reconstruction of the Glacial Deep Ocean Circulation”, University of Bremen, Bremen, November 2008.

Ocean Carbon and Biogeochemistry Workshop, Woods Hole, July 2008.

Combining data and models - statistical analysis and data assimilation in biogeochemical oceanography, EUR-OCEANS/CARBOOCEAN Summer School 2007, IFM-GEOMAR/University of Kiel, September 2007.

Sixth Workshop on the DOE Advanced Computational Software Collection (ACTS), Lawrence Berkeley National Laboratory, August 2005.

World Ocean Circulation Experiment Young Investigator Workshop on Inverse Methods, National Center for Atmospheric Research, Boulder, June 2000.

Summer School on Inverse Methods and Data Assimilation, College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, July 1999.

Summer School in Geophysical and Environmental Fluid Dynamics, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, England, September 1998.

NASA Earth Science Summer School, Jet Propulsion Laboratories, California Institute of Technology, Pasadena, July 1993.

Professional Experience and Community Service

Member of Editorial board of *Ocean Modelling*: July 2009-present.

Corresponding author for “Ocean Observations” chapter for the IPCC 5th Assessment Report (AR5).

Corresponding author for “Carbon and Other Biogeochemical Cycles” chapter for the IPCC 5th Assessment Report (AR5).

Co-author of “The Global Carbon Cycle” section of the *State of the Climate* report for 2009 and 2010 published by the American Meteorological Society.

Lead author and coordinator for the chapter on global ocean carbon storage for the Global Carbon Project’s “REgional Carbon Cycle Assessment and Processes” (RECCAP) report.

Organized a session at the 2010 AGU Ocean Sciences Meeting on *Advances in Computational Oceanography* (co-organizer: W. Weijer, LANL and P. Heimbach, MIT)

NSF Ocean Sciences Review Panel, May 2009.

Lamont-Doherty Earth Observatory Promotions and Careers Subcommittee, Junior staff representative (February 2008-August 2009).

Organized a session at the 2008 AGU Ocean Sciences Meeting on *Implicit and Adjoint Techniques in Oceanography* (co-organizer: W. Weijer, LANL)

Invited lecturer at the EUR-OCEANS/CARBOOCEAN Summer School: “Combining data and models - statistical analysis and data assimilation in biogeochemical oceanography”, IFM-GEOMAR/University of Kiel, September 2007.

Reviewed articles for *Glob. Biogeochem. Cycles*, *Nature*, *Science*, *J. Climate*, *J. Fluid Mech.*, *Ocean Modell.*, *J. Phys. Oceanogr.*, *J. Atmos. Sci.*, *Rev. Geophys.*, *Geophys. Res. Lett.*, *J. Geophys. Res.*, *Continental Shelf Res.*, *Annals of Glaciology*, *J. Mar. Sys.*, and *J. Mar. Chem.*

Reviewed proposals for NSF, NOAA, ONR, and UK NERC.

Seagoing Experience

Hudson River, Summer 2002

Deployment and recovery of ADCP for turbulence measurements.

ACCE NORTH ATLANTIC CRUISE, R/V KNORR

North Atlantic, June 1997

Collection of samples for tritium, ^3He , and $\delta^{18}\text{O}$ analyses to study ventilation of the North Atlantic.

OFFICE OF NAVAL RESEARCH LABRADOR SEA CONVECTION EXPERIMENT, R/V KNORR

Labrador Sea, February–March 1997

CTD, measurement of CFCs, and collection of samples for tritium, ^3He , and $\delta^{18}\text{O}$ analyses to study convection in the Labrador Sea.

PRIMER CRUISE, R/V ENDEAVOR

Western North Atlantic, August 1996

Collected samples for tritium, ^3He , and $\delta^{18}\text{O}$ analyses to study the Deep Western Boundary Current.

WOCE AR7W CRUISE, R/V HUDSON

Labrador Sea, May 1996

Collected samples for tritium, ^3He , and $\delta^{18}\text{O}$ analyses to study deep water formation in the Labrador Sea.

Mentoring Postdocs: Thomas Arsouze.

Graduate students: Jordan Landers (Dept. of Earth and Environmental Sciences); Francesca Terenzi (Dept. of Applied Physics and Applied Mathematics; graduated May 2009); Kevin Jones (Dept. of Earth and Environmental Sciences); Daiwei Wang (Dept. of Earth and Environmental Sciences); Kate Eckerle (Dept. of Earth and Environmental Sciences)

Interns: Sarah Starke (NSF REU: Summer 2008); James Gambino (Applied Math; Fall 2006–Spring 2008); Sergey Voronin (Applied Math and Computer Science; Spring 2006–present); Joseph Jailer-Coley (Applied Math; Fall 2006); Michael Silberman (Applied Math; Summer 2006); Timothy Merlis (Applied Math; Summer 2005–Spring 2006), Monika Kopacz (Applied Math; Summer 2003); Benjamin Ricaud (Mathematics at Ecole Nationale Supérieure de Techniques Avancées; Summer 2003).

Teaching Spring 2008. Instructor for *APPH E4210, Geophysical Fluid Dynamics*, Columbia University.

Fall 2007. Instructor for *EESC V2100: Earth's Environmental System: Climate*, Columbia University.

Spring 2007. Taught several lectures (substitute instructor for Adam Sobel) of *APPH E4210, Geophysical Fluid Dynamics*, Columbia University.

Fall 2006. Taught several lectures (substitute instructor for Adam Sobel) of *APPH E4200, Physics of Fluids*, Columbia University.

Spring 2006. Instructor for *EESC G9802, Seminar in Geochemistry: Toward an improved understanding of paleoceanographic proxies: combining models with data*, Columbia University.

http://www.ldeo.columbia.edu/~spk/Classes/G9802_PaleoProxies/paleo.html

Spring 2005. Instructor for *APPH E4210, Geophysical Fluid Dynamics*, Columbia University.

http://www.ldeo.columbia.edu/~spk/Classes/APPH4210_GFD/2005/gfd2005.html

Fall 2004. Instructor for *EESC W4950 Mathematical Methods in Earth Science*, Columbia University. (Co-taught with Paul Richards.)

Spring 2004. Instructor for *APPH E4210, Geophysical Fluid Dynamics*, Columbia University.

http://www.ldeo.columbia.edu/~spk/Classes/APPH4210_GFD/2004/gfd2004.html

Summer 2003. Instructor for *APMA S3101, Introduction to Linear Algebra*, Columbia University.

<http://www.columbia.edu/itc/applied/S3101/>

Spring 2003. Instructor for *EESC G9810, Special Topics in Mathematical Earth Science: Physics of Waves*, Columbia University.

http://www.ldeo.columbia.edu/~spk/Classes/G9810_Waves/waves.html

Spring 2000. Teaching Assistant for *weather and climate laboratory: experiments in geophysical fluid dynamics*, Massachusetts Institute of Technology.

Fall 1999. Teaching Assistant for *Laboratory experiments in geophysical fluid dynamics*, Columbia University.

Fall 1998. Organized a seminar with Dr. Martin Visbeck on *The Effect of Rotation on Geophysical Fluids*, Columbia University.

Fall 1997. Organized a seminar with Dr. Martin Visbeck on *Turbulent Mixing in the Ocean*, Columbia University.

Spring 1995. Teaching Assistant for *Planet Earth*, Columbia University.

Fall 1993. Teaching Assistant for *Introduction to Earth Sciences I*, Columbia University.