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STEPHEN MATTHEW GRIFFIES

EDUCATION

- 1988–1993 University of Pennsylvania, Philadelphia, USA • Theoretical Physics Ph.D., June 1993
1987–1988 University of Washington, Seattle, USA • Physics undergraduate student
1986–1987 Northwestern University, Evanston, USA • Applied mathematics masters, June 1987
1981–1986 Louisiana State University, Baton Rouge, USA • Chemical engineering bachelor, June 1986

EMPLOYMENT AND APPOINTMENTS

- 2006–present GFDL Ocean Model Development Team co-Leader
2005 Visiting Scientist, CSIRO Marine and Atmospheric Research, Hobart, Australia
2001–2005 GFDL Oceans and Climate Group Leader
2001–2002 GFDL Ocean Model Development Team co-Leader
2000–2001 GFDL Climate Model Development Team Leader
2000–present GFDL Physical Scientist, Grade GS-14
1997–2000 GFDL Physical Scientist, Grade GS-13
1996–1997 GFDL Physical Scientist, Grade GS-12
1995–1996 GFDL Visiting Research Scientist
1993–1995 UCAR Global & Climate Change Fellow at Princeton University
1988–1993 University of Pennsylvania Physics Graduate Research Fellow
1984–1986 Louisiana State University Chemical Engineering Research Technician

OCEANOGRAPHIC CRUISES

- 1993 **Technical Assistant:** WOCE Line AR7W / Atlantic Circulation Experiment, Labrador Sea, *CCGS Hudson* (John Lazier, Chief Scientist)

AWARDS

2001 NOAA/Oceanic and Atmospheric Research Outstanding Scientific Paper
1999 NOAA/Oceanic and Atmospheric Research Outstanding Scientific Paper
1998 NOAA/Oceanic and Atmospheric Research Employee of the Year
1997 NOAA/Environmental Research Laboratories Outstanding Scientific Paper

EDUCATIONAL ADVISING ACTIVITIES

Shafer Smith: co-advisor for Princeton post-doc 1999-2002; now faculty at Courant Institute, NYU
Harper Simmons: co-advisor for GFDL visiting scientist 2001-2002; now at International Arctic Research Center, Alaska
Jaison Kurian: External thesis examiner, Indian Institute of Science, PhD 2007
Andreas Klockner: co-advisor, University of Tasmania, PhD student 2005-2009
Michael Bates: co-advisor, University of New South Wales, PhD student, 2008-present

PROFESSIONAL SERVICES AND ORGANIZATION MEMBERSHIPS

CLIVAR Working Group on Ocean Model Development (2000-present; co-chair since 2004)
CLIVAR Scientific Steering Group (since 2006)
CLIVAR Working Group on Coupled Modeling (ex officio since 2004)
Associate Editor of **Ocean Modelling** (2007-present)
Editorial Board of **Ocean Science** (2004-2007)
Member of the American Geophysical Union (since 1993)
Member of the American Meteorological Society (since 1993)

INVITED LECTURES AND PRESENTATIONS

Mar 2009 *Physical Processes Setting the Ocean's Water Masses*: four lectures at Université Catholique de Louvain, Belgium.
Apr 2008 *Physical Problems in Simulating the Ocean Climate System*: presentation given during a workshop on Oceans and Climate at Yale University.
Mar 2008 *Physical Problems in Simulating the Ocean Climate System*: presentation given during a special session on Climate Physics at the American Physical Society's March Meeting of Condensed Matter Physics.
Nov 2007 *Ocean Model Fundamentals*: lectures comprising a 20 hour short course at the University of Tasmania, Australia.
Aug 2006 *Ocean Model Fundamentals*: two lectures at the NSF summer school, *Modern Mathematical Methods in Physical Oceanography*, Breckenridge, USA.

- Oct 2004 *Ocean Model Fundamentals*: 20 hour short course at the *Indian Intensive School on Large-Scale Ocean Modelling*. Bangalore, India.
- Sep 2004 *Ocean Model Fundamentals*: three lectures at the *Global Ocean Data Assimilation Experiment Summer School*. La Londe Les Maures, France.
- May 2003 *Ocean Climate Modeling at NOAA-GFDL*: two presentations for a workshop on ocean modeling. Hobart, Australia.
- May 2002 *Ocean Climate Modeling with MOM4*: three presentations for a workshop on ocean modeling. Kiel, Germany.
- Jan 2001 *Ocean Dynamics and Modeling*: three lectures at La Escuela de Verano de Universidad de Concepción, Chile.
- Mar 1999 *Ocean and Climate Modeling*: two presentations at Conference on Global Climate. Barcelona, Spain.
- Sep-Dec 1993 Co-Lecturer: Atmospheric and Oceanic Data Assimilation, Princeton University
- 1990–1993 Instructor: Undergraduate Physics Laboratory, University of Pennsylvania
- 1990–1993 Teaching Assistant: General Relativity and Quantum Field Theory, University of Pennsylvania

CONVENER/ORGANIZER OF WORKSHOPS AND MEETINGS

- Apr 2009 *CLIVAR Workshop on Ocean Mesoscale Eddies: Observations, Simulations, and Parameterizations*, Exeter, UK.
- Aug 2007 *CLIVAR Workshop on Numerical Methods in Ocean Modelling*, Bergen, Norway.
- Nov 2005 *CLIVAR Workshop on Modelling the Southern Ocean*, Hobart, Australia.
- Jun 2004 *CLIVAR Workshop on Evaluating the Ocean Component of IPCC Models*, Princeton, USA.
- Aug 2002 *Workshop on Z-coordinate Ocean Modeling*, Massachusetts Institute of Technology, USA.
- Nov 1999 *Meeting of Z-coordinate Ocean Modeling at GFDL, LANL, MIT, and NCAR*, Princeton, USA.
- Jul 1999 International Union of Geodesy and Geophysics Session on Ocean/Atmosphere Variability and Predictability, Birmingham, UK.

INVITED PARTICIPANT IN ADVANCED SCHOOLS

- Jan 1998 NATO Advanced Study Institute: *Ocean Modeling and Parameterization*, Les Houches, France.
- Jan 1996 NATO Advanced Study Institute: *Climate Variability and Predictability*, Les Houches, France.
- Jul 1994 Meeting of UCAR Global and Climate Change Fellows. Steamboat Springs, USA.
- Jul 1992 Theoretical Advanced Study Institute: *From String Theory to Black Holes*, Boulder, USA.
- Jul 1991 High Energy Physics and Cosmology School, Center for Theoretical Physics. Trieste, Italy.
- Jun 1991 Theoretical Physics Summer School: *Particle Physics in the 1990's*, Les Houches, France.

JOURNAL PUBLICATIONS

1. Evaluating the Uncertainty Induced by the Virtual Salt Flux Assumption in Climate Simulations and Future Projections, 2009: J. Yin, R.J. Stouffer, M.J. Spelman, and **S.M. Griffies**, *submitted to Journal of Climate*.
2. Improving oceanic overflow representation in climate models: the Gravity Current Entrainment Climate Process Team, 2009: S. Legg, B. Briegleb, Y. Chang, E.P. Chassignet, G. Danabasoglu, T. Ezer, A.L. Gordon, **S.M. Griffies**, R. Hallberg, L. Jackson, W. Large, T. Özgökmen, H. Peters, J. Price, U. Riemenschneider, W. Wu, X. Xu, and J. Yang. *Bulletin of the American Meteorological Society* in press.
3. Coordinated Ocean-ice Reference Experiments (COREs), 2009: **S.M. Griffies**, A. Biastoch, C. Böning, F. Bryan, E. Chassignet, M. England, R. Gerdes, H. Haak, R.W. Hallberg, W. Hazeleger, J. Jungclauss, W.G. Large, G. Madec, B.L. Samuels, M. Scheinert, A. Sen Gupta, C.A. Severijns, H.L. Simmons, A.-M. Treguier, M. Winton, S. Yeager, J. Yin. *Ocean Modelling*, **26**, 1–46.
4. Effects in a climate model of slope tapering in neutral physics schemes, 2007: A. Gnanadesikan, **S.M. Griffies**, B.L. Samuels, *Ocean Modelling*, **16**, 1–16.
5. Algorithms for density, potential temperature, conservative temperature and freezing temperature of seawater, 2006: D.R. Jackett, T.J. McDougall, R. Feistel, D.G. Wright, and **S.M. Griffies**. *Journal of Atmospheric and Oceanic Technology*, **23**, 1709–1728.
6. GFDL’s CM2 Global Coupled Climate Models-Part 2: The Baseline Ocean Simulation, 2006: A. Gnanadesikan, K.W. Dixon, **S.M. Griffies**, V. Balaji, J.A. Beesley, W.F. Cooke, T.L. Delworth, R. Gerdes, M.J. Harrison, I.M. Held, W.J. Hurlin, H.-C. Lee, Z. Liang, G. Nong, R.C. Pacanowski, A. Rosati, J. Russell, B.L. Samuels, S.M. Song, M.J. Spelman, R.J. Stouffer, C.O. Sweeney, G. Vecchi, M. Winton, A.T. Wittenberg, F. Zeng, and R. Zhang. *Journal of Climate*, **19**, 675–697.
7. GFDL’s CM2 Global Coupled Climate Models-Part 1: Formulation and Simulation Characteristics, 2006: T.L. Delworth, A.J. Broccoli, A. Rosati, R.J. Stouffer, V. Balaji, J.A. Beesley, W.F. Cooke, K.W. Dixon, J. Dunne, K.A. Dunne, J.W. Durachta, K.L. Findell, P. Ginoux, A. Gnanadesikan, C.T. Gordon, **S.M. Griffies**, R. Gudgel, M.J. Harrison, I.M. Held, R.S. Hemler, L.W. Horowitz, S.A. Klein, T.R. Knutson, P.J. Kushner, A.L. Langenhorst, H.-C. Lee, S.J. Lin, L. Lu, S.L. Malyshev, P.C. Milly, V. Ramaswamy, J. Russell, M.D. Schwarzkopf, E. Shevliakova, J. Sirutis, M.J. Spelman, W.F. Stern, M. Winton, A.T. Wittenberg, B. Wyman, F. Zeng, R. Zhang. *Journal of Climate*, **19**, 643–674.
8. Sensitivity of a global ocean model to increased run-off from Greenland, 2006: R. Gerdes, W.J. Hurlin, and **S.M. Griffies**, *Ocean Modelling*, **12**, 416–435.
9. Formulation of an ocean model for global climate simulations, 2005: **S.M. Griffies**, A. Gnanadesikan, K.W. Dixon, J.P. Dunne, R. Gerdes, M.J. Harrison, A. Rosati, J. Russell, B.L. Samuels, M.J. Spelman, M. Winton, R. Zhang. *Ocean Science*, **1**, 45–79.
10. Impacts of shortwave penetration depth on large-scale ocean circulation and heat transport, 2005: C. Sweeney, A. Gnanadesikan, **S. M. Griffies**, M. J. Harrison, A. J. Rosati, and B. L. Samuels. *Journal of Physical Oceanography*, **35**, 1103–1119.
11. Tracer Conservation with an Explicit Free Surface Method for Z-coordinate Ocean Models, 2001: **S.M. Griffies**, R.C. Pacanowski, M. Schmidt, and V. Balaji, *Monthly Weather Review*, **129**, 1081–1098.
12. Developments in Ocean Climate Modelling, 2000: **S.M. Griffies**, C. Böning, F.O. Bryan, E.P. Chassignet, R. Gerdes, H. Hasumi, A. Hirst, A.-M. Treguier, and D. Webb, *Ocean Modelling*, **2**, 123–192. **NOAA/Oceanic and Atmospheric Research Laboratories 2001 Outstanding Scientific Review Paper Award.**
13. Biharmonic friction with a Smagorinsky-like viscosity for use in large-scale eddy-permitting ocean models, 2000: **S.M. Griffies** and R. W. Hallberg. *Monthly Weather Review*, **128**, 2935–2946.

14. Spurious diapycnal mixing associated with advection in a z-coordinate ocean model, 2000: **S.M. Griffies**, R. C. Pacanowski, and R. W. Hallberg. *Monthly Weather Review*, **128**, 538–564.
15. A conceptual framework for predictability studies, 1999: T. Schneider and **S.M. Griffies**. *Journal of Climate*, **12**, 3133–3155.
16. The Gent-McWilliams Skew-Flux, 1998: **S.M. Griffies**, *Journal of Physical Oceanography*, **28**, 831–841.
17. Isonutral diffusion in a z-coordinate ocean model, 1998: **S.M. Griffies**, A. Gnanadesikan, R. C. Pacanowski, V. Larichev, J. K. Dukowicz, and R. D. Smith, *Journal of Physical Oceanography*, **28**, 805–830. **NOAA/Oceanic and Atmospheric Research Laboratories 1999 Outstanding Scientific Paper Award**.
18. A Predictability Study of Simulated North Atlantic Multidecadal Variability, 1997: **S.M. Griffies** and K. Bryan, *Climate Dynamics*, **13**, 459–488.
19. Predictability of North Atlantic Multidecadal Climate Variability, 1997: **S.M. Griffies** and K. Bryan, *Science* **275**, 181–184. **NOAA/Environmental Research Laboratories 1997 Outstanding Scientific Paper Award**.
20. Reply to Comment on “Instability of the Thermohaline Circulation with Respect to Mixed Boundary Conditions”, 1996: J. R. Toggweiler, E. Tziperman, Y. Feliks, K. Bryan, **S.M. Griffies**, and B. Samuels, *Journal of Physical Oceanography*, **26**, 1106–1110.
21. A Linear Thermohaline Oscillator Driven by Stochastic Atmospheric Forcing, 1995: **S.M. Griffies** and E. Tziperman, *Journal of Climate*, **8**, 2440–2453.

BOOKS, CHAPTERS, MANUALS, AND UNREFEREED ARTICLES

1. Sampling physical ocean fields in WCRP CMIP5 simulations, 2009: **S.M. Griffies**, A.J. Adcroft, H. Aiki, V. Balaji, M. Bentson, F. Bryan, G. Danabasoglu, S. Denvil, H. Drange, M. England, J. Gregory, R.W. Hallberg, S. Legg, T. Martin, T. McDougall, A. Pirani, G. Schmidt, D. Stevens, and H. Tsujino. Southampton, UK, International CLIVAR Project Office, 56pp. (ICPO Publication Series, 137) <http://eprints.soton.ac.uk/65415/>
2. Formulating the equations of an ocean model, 2008: **S.M. Griffies** and A.J. Adcroft. In **Ocean Modeling in an Eddying Regime**, Geophysical Monograph 177, M.W. Hecht and H. Hasumi, editors, Washington, DC: American Geophysical Union, 281–318.
3. **Elements of MOM4p1**, 2008: **S.M. Griffies**, NOAA/Geophysical Fluid Dynamics Laboratory Technical Report No. 6. Princeton, USA. 405 pages.
4. Furthering the science of ocean climate modelling, 2008: **S.M. Griffies**, H. Banks and A. Pirani. *CLIVAR Exchanges*, 13(1), 2.
5. Report from the CLIVAR Working Group on ocean model development (WGOMD), 2008: A. Pirani, **S.M. Griffies**, and H. Banks. *CLIVAR Exchanges*, 13(1), 30–32.
6. Ocean modelling with MOM, 2007: **S.M. Griffies**, M.J. Harrison, R.C. Pacanowski, and A. Rosati, *CLIVAR Exchanges*, Newsletter of the Climate Variability and Predictability Programme. Issue No. **42** (Volume 12 No 3), pages 3–5.
7. Design considerations for Coordinated Ocean-ice Reference Experiments, 2007: **S.M. Griffies**, C. Böning, and A.M. Treguier, *Flux News*, a publication of the WCRP Working Group on Surface Fluxes, Issue **3**, pages 3–5.
8. Some ocean model fundamentals, 2005: **S.M. Griffies**, in **Ocean Weather Forecasting: an Integrated View of Oceanography**, edited by E.P. Chassignet and J. Verron, pages 19–73. Springer Publishing.

9. **Fundamentals of Ocean Climate Models**, 2004: **S.M. Griffies**. *Princeton University Press*. Princeton, USA. 518+xxxiv pages.
10. **A Technical Guide to MOM4**, 2004: **S.M. Griffies**, M. J. Harrison, R.C. Pacanowski, and A. Rosati, NOAA/Geophysical Fluid Dynamics Laboratory Technical Report No. 5. Princeton, USA. 337 pages.
11. An Introduction to Linear Predictability Analysis, 2003: **S.M. Griffies**. In **Global Climate: Current Research and Uncertainties in the Climate System**. X. Rodo and R. A. Comín, editors. Springer.
12. An Introduction to Ocean Climate Modeling. 2003: **S.M. Griffies**, In **Global Climate: Current Research and Uncertainties in the Climate System**. X. Rodo and R. A. Comín, editors. Springer.
13. Physical climate processes and feedbacks. In **Climate Change 2001: Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change**, 2001: T.F. Stocker, G. K. C. Clarke, H. Le Treut, R. S. Lindzen, V. P. Meleshko, R. K. Mugara, T. N. Palmer, R. T. Pierrehumbert, P. J. Sellers, K. E. Trenberth, J. Willebrand, R. B. Alley, O. E. Anisimov, C. Appenzeller, R. G. Barry, J. J. Bates, R. Bindaschadler, G. B. Bonan, C. W. Bony, S. Bony, H. Bryden, M. A. Cane, J. A. Curry, T. Delworth, A. S. Denning, R. E. Dickinson, K. Echelmeyer, K. Emanuel, G. Flato, I. Fung, M. Geller, P. R. Gent, **S.M. Griffies**, I. Held, A. Henderson-Sellers, A. A. M. Holtslag, F. Hourdin, J. W. Hurrell, V. M. Kattsov, P. D. Killworth, Y. Kushnir, W. G. Large, M. Latif, P. Lemke, M. E. Mann, G. Meehl, U. Mikolajewicz, W. O'Hirok, C. L. Parkinson, A. Payne, A. Pitman, J. Polcher, I. Polyakov, V. Ramaswamy, P. J. Rasch, E. P. Salathe, C. Schr, R. W. Schmitt, T. G. Shepherd, B. J. Soden, R. W. Spencer, P. Taylor, A. Timmermann, K. Y. Vinnikov, M. Visbeck, S. E. Wijffels, and M. Wild. Cambridge, UK: Cambridge University Press, 418-470.
14. **The MOM 3 Manual**, 1999: R. C. Pacanowski and **S.M. Griffies**. NOAA/Geophysical Fluid Dynamics Laboratory Technical Report No. 4. Princeton, USA. 680 pages.
15. Predictability of North Atlantic climate on decadal times scales estimated using a coupled ocean-atmosphere model, 1997: K. Bryan and **S.M. Griffies**. *International WOCE Newsletter*, **26**, 5–9.
16. Predictability of North Atlantic climate variability on multidecadal time scales, 1994: **S.M. Griffies** and K. Bryan. *The Atlantic Climate Change Program, Proceedings from the principal investigators meeting*. NOAA: University Corporation for Atmospheric Research, 77–80.

THEORETICAL PHYSICS PUBLICATIONS

1. Local and global aspects of domain wall space-times, 1993: M. Cvetič, **S.M. Griffies**, and H. H. Soleng, *Physical Review D* **48**, 2613–2634.
2. Nonextreme and ultraextreme domain walls and their global space-times, 1993: M. Cvetič, **S.M. Griffies**, and H. H. Soleng, *Physical Review Letters*, **71**, 670–673.
3. Cauchy horizons, thermodynamics and closed time-like curves in planar supersymmetric space-times, 1993: M. Cvetič, R. Davis, **S.M. Griffies**, and H. H. Soleng, *Physical Review Letters*, **70**, 1191–1194.
4. Domain walls in $N = 1$ supergravity, 1993: M. Cvetič and **S.M. Griffies**, 1993: in **The Proceedings of the International Symposium on Black Holes, Membranes, Wormholes, and Superstrings**. (S. Kalara and D. Nanopoulos editors), World Scientific.
5. Nonperturbative stability of supergravity and superstring vacua, 1993: M. Cvetič, **S.M. Griffies**, and S.-J. Rey, *Nuclear Physics B* **389**, 3–24.
6. Gravitational effects in supersymmetric domain wall backgrounds, 1992: M. Cvetič and **S.M. Griffies**, *Physics Letters* **285B**, 27–34.
7. Static domain walls in $N = 1$ supergravity, 1992: M. Cvetič, **S.M. Griffies**, and S.-J. Rey, *Nuclear Physics B* **381**, 301–328.

8. Two skyrmion interaction for the Atiyah-Manton ansatz, 1990: A. Hosaka, **S.M. Griffies**, M. Oka, and R. D. Amado, *Physics Letters* **251B**, 1–5.

RESEARCH STATEMENT

My research interests include (1) understanding the ocean's role in the global climate system, (2) formulating physically and mathematically sound subgrid-scale parameterizations for ocean dynamics, especially those related to ocean mesoscale eddies, (3) developing robust and efficient numerical algorithms for ocean circulation models, (4) articulating the fundamentals of ocean climate models, and (5) studying methods for quantifying predictability and using these methods to understand climate variability.

An overall goal of my research and development work is to contribute to the evolution of ocean climate modeling into a rationally driven scientific endeavor. This, as well as my training in theoretical physics, motivates me to approach research from fundamental physical, mathematical, and numerical perspectives, and to present work in a pedagogical manner. More precisely, my work can be split into two main areas: the design, construction, and support of numerical ocean climate models, and the use and analysis of climate model simulations. There is a synergy between model building and model use, and such provides an underlying theme to my research.

Computer models that simulate the ocean are the main tool scientists use to address large-scale ocean climate questions. These questions have relevance over a broad range of issues, from curiosity driven research to policy relevant scenarios. My work has resulted in papers of notable impact, such as those focusing on subgrid-scale parameterizations. It has also led me to become the leader of the Modular Ocean Model (MOM) effort, where MOM is used by hundreds of ocean climate scientists worldwide. Finally, this work has motivated me to compose a monograph on the fundamentals of ocean climate models. This book aims to provide the modeling community, especially its students, with a thorough pedagogical discussion of what it takes to formulate and to build an ocean climate model.

My use of ocean climate models has thus far emphasized the large-scale circulation, especially that in the North Atlantic. Out of this work came the first systematic study of simulated North Atlantic predictability, as well as novel methods for quantifying climate predictability. I am presently involved in projects aiming to diagnose and understand differences between global climate simulations achieved with various high-end models. Understanding differences between model simulations, and providing methods for achieving systematic comparisons, is a critical and nontrivial goal of ocean climate modelers, especially as simulations become more widely used as the basis for government policy.

I have been a leader in the Geophysical Fluid Dynamics Laboratory's (GFDL's) ocean climate modeling efforts since the late 1990's. This work has most prominently involved my providing intellectual and management leadership for the development of MOM, which has been used in GFDL's coupled earth system models. As leader of GFDL's Oceans and Climate Group between 2001-2005, I was responsible for developing research agendas for the group, as well as the recruitment of research scientists for sabbatical visits and/or for joining our staff. I also provide leadership in the international ocean climate science community as chair (since 2004) of the Clivar Working Group for Ocean Model Development. In both leadership roles, I have set up collaborative projects with national and international researchers. In particular, this collaborative effort has led to my taking a 10 month visit to CSIRO Marine and Atmospheric Research in Australia during 2005. This time abroad has strengthened the scientific interactions between Australian ocean scientists and GFDL.