

Leslie M. Smith

University of Wisconsin
480 Lincoln Drive, Madison, WI 53706
e-mail: lsmith@math.wisc.edu

Education

- 9/88 Ph.D., Applied Mathematics, Massachusetts Institute of Technology, Cambridge, MA. Thesis title: *An upper bound with correct scaling laws for turbulent shear flows*; advisor: Professor Willem V. R. Malkus.
- 6/83 B.A. Cum Laude in Physics, Harvard University, Cambridge, MA.

Present Position

- since 7/02 University of Wisconsin, Madison, WI.
Professor, Departments of Mathematics and Eng. Physics

Previous Positions

- 6/12-5/14 Chair, Department of Mathematics
- 6/05-5/08 University of Wisconsin, Madison, WI.
- 7/97-6/02 University of Wisconsin, Madison, WI.
Associate Professor, Departments of Math. and Mech. Eng.
- 7/93-6/98 Yale University, New Haven, CT.
Assistant Professor, Department of Mechanical Engineering.
- 9/91-6/93 Princeton University, Princeton, NJ.
Research Associate, Program in Applied and Computational Mathematics and Department of Mechanical and Aerospace Engineering.
- 5/91-8/91 Université Libre de Bruxelles, Bruxelles, Belgium.
Visiting research scientist in the Department of Statistical Physics.
- 9/88-4/91 The Center for Turbulence Research, Stanford University & NASA/Ames Research Center, Stanford, CA. Post-doctoral fellow.

Teaching Activities

- '98-'15 University of Wisconsin:
Math 801 Topics in Applied Mathematics: Rotating Stratified Fluid Flow with Application to Atmosphere-Ocean Dynamics
Math 705 Mathematical Fluid Dynamics
Math 703 Methods of Applied Mathematics
Dynamics Seminar: Geophysical Turbulence (with Atmospheric and Oceanic Sciences and Physics)
Math 319 Techniques in Ordinary Differential Equations
Mechanical Engineering 563 Fluid Mechanics
Mechanical Engineering 363 Fluid Mechanics
Engineering Physics 548 Engineering Analysis II
Math 320 Linear Algebra and Differential Equations
Math 213 Calculus and Differential Equations
Math 221 Calculus: FIG leader for Socio-Economic Inequality and Career Choice (Math 221, Chem 109, Sociology 134)
- '93-'97 Yale University:
Fluid Mechanics
The Statistical Physics of Turbulence
Ordinary and Partial Differential Equations with Applications
Introduction to Computing for Scientists and Engineers
Faculty Advisor for Perspectives on Science: MegaScience and Public Policy
Supervisor for Senior Theses: development of computer software for engineering design of turbulent flow system
- '83-'87 Massachusetts Institute of Technology, Department of Mathematics. Teaching assistant: Complex Variable Theory and Methods of Applied Mathematics (undergraduate and graduate levels).
- 1985 Woods Hole Oceanographic Institute & Massachusetts Institute of Technology joint program, Woods Hole, MA.
Instructor: Partial Differential Equations (graduate level).

Current Grants

- 6/15-5/18 PI with co-PIs J. Martin (UW-Madison, AOS) & S. Stechmann (UW-Madison, Math), *Minimal Models for Investigating the Influence of Latent Heat Release on Mid-Latitude Dynamics*. National Science Foundation, Physical and Dynamical Meteorology. \$750K
- 7/12-6/17 co-PI with A. Seeger (PI) & A. Zlatos (co-PI), *RTG: Analysis and Applications*. Division of Mathematical Sciences. \$1,168,483K
- 1/12-12/15 co-PI with S. Kurien (LANL), A. Pouquet (NCAR) & R. Ecke (LANL), *Parameter Studies of Boussinesq Flows*. DOE Innovative and Novel Computational Impact on Theory and Experiment (INCITE): 34,000,000 core hours on the IBM Blue Gene/Q at Argonne National Laboratory.

Previous Grants

- 9/10-9/14 PI with co-PIs S. Kurien (LANL) & A. Pouquet (NCAR), *CMG Collaborative Research: Analysis and Modeling of Rotating, Stratified Flows*. National Science Foundation, Collaborations in Mathematics and Geoscience. \$900,000.
- 9/10-9/14 PI, *Inertia-gravity Waves in Geophysical Flows*. National Science Foundation, Division of Mathematical Sciences. \$252,810
- 1/09-12/11 co-PI with S. Kurien (LANL), M. Taylor (Sandia) & R. Balakrishnan (Argonne), *Numerical Study of Multiscale Coupling in Low-Aspect Ratio Rotating Stratified Turbulence*. DOE Innovative and Novel Computational Impact on Theory and Experiment (INCITE): 25,000,000 core hours on the IBM Blue Gene/P at Argonne National Laboratory.
- 8/05-7/09 co-PI with Z. Liu (UW-Madison, AOS), S. Kurien (LANL) & B. Wingate (LANL), *Multi-Scale Modeling in Geophysical and Climate Modeling*. DOE Multi-Scale Mathematics Research and Education. \$846,058

- 8/05-7/09 PI with co-PIs S. Kurien (LANL) & B. Wingate (LANL), *Non-Hydrostatic Effects and New Diagnostics for the Long-Time Dynamics of Rotating and Stratified Flows*. National Science Foundation, Collaborations in Mathematics and Geoscience. \$455,332
- 9/05-8/08 co-PI with C. Rutland (UW-Madison, ME), *LES Modeling for Engineering and Geophysical Flows with Rotation*. National Science Foundation, Division of Engineering. \$180,000
- 7/03-6/07 PI, *Mechanisms for the Formation of Coherent Structures From Small-Scale Turbulence in Anisotropic Flows*. National Science Foundation, Division of Mathematical Sciences \$180,000
- 7/05-6/07 PI, *Dispersive-Wave Turbulence and the Long-Time Prediction of Geophysical Flows*. UW Vilas Associate Award. \$38,395
- 9/05-8/06 co-PI with S. Jin (UW), J. Rossmannith (UW), F. Waleffe (UW), *Multiscale Computations in Astrophysics, Geophysics, Hydrodynamics, Kinetic and Quantum Applications*. National Science Foundation, Super-Computing Environments in the Mathematical Sciences. \$73,000
- 9/00-8/03 *Wave Turbulence in Atmospheric and Oceanic Flows*. National Science Foundation. \$200,000
- 4/96-4/00 *Numerical Studies of Three-Dimensional Turbulence in Small-Aspect-Ratio Domains*. National Science Foundation. \$197,858
- 10/93-10/96 *A Two-Scale Approach to $\bar{K} - \bar{\epsilon}$ Modeling for Nonequilibrium Turbulence*. Office of Naval Research. \$106,039
- 6/99-5/00 *Numerical Study of Large-Scale Dynamics in Stratified and Rotating, Stratified Turbulence Forced at Small Scales*. Wisconsin Alumni Research Fund. \$14,589
- 10/99-9/00 *The Formation of Cyclones from Background Noise in Rotating Turbulence: Experiments in a Rotating Tank*. Abbott Laboratories, Illinois. \$2,000
- 5/01-7/31 *Generation of Slow, Large Scales in Forced, Rotating, Stratified Turbulence*. National Center for Supercomputing Applications. 10000 Origin2000 hours

- 4/99-3/00 *The Structures and Statistics of Stratified Turbulence Forced at Small Scales*. National Center for Supercomputing Applications. 9150 Origin2000 hours
- 8/96-8/98 Computer time for *Small-Aspect-Ratio Turbulence and The Modeling of Geophysical Flows*. The Cornell Theory Center. 10,000 SP2 hours
- 10/95-10/97 Computer time for *The Crossover from Two- to Three-Dimensional Turbulence and the Modeling of Geophysical Flows*. The Maui High Performance Computing Center. 6,000 SP2 hours
- 8/95-8/96 Computer time for *Small-Aspect-Ratio Turbulence and The Modeling of Geophysical Flows*. The Cornell Theory Center. 2,000 SP2 hours
- 8/93-8/95 Computer time for *High Resolution Simulations of Passive Scalar Transport in Atmospheric Flows*. The Maui High Performance Computing Center. 2,000 SP2 hours
- 5/91-10/91 *Exploration of the Cusp Behavior of the RNG Eddy Viscosity Near the Cutoff Wavenumber*. Air Force Office of Scientific Research.

Personal

Date of Birth: Aug. 15, 1961

Gender: Female

Citizenship: USA

Family: Married, 2 Children

Research Interests

Applied mathematics; Theory, modeling and numerical computations of fluid dynamical systems with applications in atmosphere/ocean/climate sciences and engineering; Field theoretical techniques, the dynamic renormalization group and universality in complex systems.

Refereed Journal Publications

- Hernandez-Duenas, G., Smith, L.M. & Stechmann, S. 2015 Stability and Instability Criteria for Idealized Precipitating Hydrodynamics, *J. Atmos. Sci.* **72**, 2379-2393.
- Waleffe, F., Boonkasame, A. & Smith, L.M. 2015 Heat Transport by Coherent Rayleigh-Bénard Convection, *Phys. Fluids* **27** 051702.

- Hernandez-Duenas, G., Smith, L.M. & Stechmann, S. 2014 Investigation of Boussinesq Dynamics Using Intermediate Models Based on Wave-Vortical Interactions *J. Fluid Mech.* **717**, 576-611.
- Kurien, S. & Smith, L.M. 2014 Effect of Rotation and Domain Aspect-Ratio on Layer Formation in Strongly Stratified Boussinesq Flows *The Journal of Turbulence* **15**, 241-271.
- Remmel, R., Sukhatme, J. & Smith, L.M. 2014 Nonlinear Gravity Wave Interactions in Stratified Turbulence, *Theoret. Comput. Fluid Dyn.* **28**, 131-145.
- Hernandez-Duenas, G., Majda, A., Smith, L.M. & Stechmann, S. 2013 Minimal Models for Precipitating, Turbulent Convection, *J. Fluid Mech.* **717**, 576 - 611.
- Sukhatme, J., Majda, A. & Smith, L.M. 2012 Two-Dimensional Moist Stratified Turbulence, *Phys. Fluids* **34**, 036602.
- Deng, Q., Smith, L.M. & Majda, A.J. 2012 Tropical Cyclogenesis and Vertical Shear in a Moist Boussinesq Model, *J. Fluid Mech.* **706**, 384-412.
- Kurien, S. & Smith, L.M. 2011 Asymptotics of Unit Burger Number Rotating and Stratified Flows for Small Aspect Ratio. *Physica D* **241**, 149 - 163.
- Remmel, M., Sukhatme, J. & Smith, L.M. 2010 Nonlinear Inertia-Gravity Wave-Mode Interactions in Three Dimensional Rotating Stratified Flows, *Communications in Mathematical Sciences* **8**, 357 - 376.
- Liu, W., Bretherton, F., Liu, Z., Smith, L.M., Lu, H. & Rutland, C.J. 2010 Breaking of progressive internal gravity waves: Convective instability and shear instability, *Journal of Physical Oceanography*, doi: 10.1175/2010JPO4432.1
- Sukhatme, J. & Smith, L.M. 2009 Local and Nonlocal Dispersive Turbulence, *Phys. Fluids* **21**. 056603.
- Remmel, M. & Smith, L.M. 2009 New Intermediate Models for Rotating Shallow Water and an Investigation of the Preference for Anticyclones, *J. Fluid Mech.* **635**, 321-359.
- Lu, H., Rutland, C.J. & Smith, L.M. 2008 A Posteriori Tests of One-Equation LES Modeling of Rotating Turbulence, *International Journal of Modern Physics C* **19**, 1949-1964.
- Sukhatme, J. & Smith, L.M. 2008 Effects of Dispersion on Vortical and Wave Modes in 3D Rotating Stratified Flows: Large-Scale Forcing, *Geophysical and Astrophysical Fluid Dynamics* **102**, 437-455.

- Lu, H., Rutland, C.J. & Smith, L.M. 2007 A-Priori Tests of One-Equation LES Modeling of Rotating Turbulence, *Journal of Turbulence* **8**, N 37.
- Sukhatme, J. & Smith, L.M. 2007 Self-Similarity in Decaying Two-Dimensional Stably Stratified Adjustment, *Phys. Fluids* **19**, 036603.
- Smith, L.M. & Lee, Y. 2007 A Mechanism for the Formation of Geophysical and Planetary Zonal Flows, *J. Fluid Mech.* **576**, 405-424.
- Kurien, S., Smith, L.M. & Wingate, B. 2006 On the Two-Point Correlation of Potential Vorticity in Rotating and Stratified Turbulence, *J. Fluid Mech.* **555**, 131-140.
- Smith, L.M. & Lee, Y. 2005 On Near-Resonances and Symmetry Breaking in Forced Rotating Flows at Moderate Rossby Number, *J. Fluid Mech.* **535**, 111-142.
- Lee, Y. & Smith, L.M. 2003 Stability of Rossby Waves in the β -Plane Approximation, *Physica D* **179**, 53-91.
- Smith, L.M. & Waleffe, F. 2002 Generation of Slow, Large Scales in Forced, Rotating, Stratified Turbulence, *J. Fluid Mech.* **451**, 145-168.
- Smith, L.M. & Waleffe, F. 1999 Transfer of Energy to 2D Large Scales in Forced, Rotating 3D Turbulence. *Phys. Fluids* **11**, 1608-1622.
- Smith, L.M. & Yakhot, V. 1997 The Onset of Intermittency in Two-Dimensional Decaying Turbulence. *Phys. Rev. E.* **55**, 5458
- Smith, L.M., Chasnov, J. & Waleffe, F. 1996 The Crossover From Two- to Three-Dimensional Turbulence. *Phys. Rev. Lett.* **77**, 2467
- Sirovich, L., Smith, L.M. & Yakhot, V. 1995 Energy Spectrum of Homogeneous and Isotropic Turbulence in Far Dissipation Range. *Phys. Rev. Lett.* **72**, 344
- Smith, L.M. & Yakhot, V. 1994 Finite-Size Effects in Forced Two-Dimensional Turbulence. *J. Fluid Mech.* **274**, 115
- Salmon, R. & Smith, L.M. 1994 Hamiltonian derivation of the nonhydrostatic pressure-coordinate model. *Q. J. R. Meteorol. Soc.* **120**, 1409
- Smith, L.M. & Yakhot, V. 1993 Bose Condensation and Small-Scale Structure Generation in a Random Force Driven 2D Turbulence. *Phys. Rev. Lett.* **71**, 352

- Smith, L.M. & Yakhot, V. 1993 Short and long-time behavior of eddy-viscosity models. *Theor. and Comput. Fluid Dynamics* **4**, 197
- Yakhot, V. & Smith, L.M. 1992 The renormalization group, the ϵ -expansion, and derivation of turbulence models. *J. Sci. Comput.*, **3**, 35
- Smith, L.M. & Reynolds, W.C. 1992 On the Yakhot-Orszag renormalization group method for deriving turbulence statistics and models. *Phys. Fluids A* **2**, 362
- Smith, L.M. & Reynolds, W.C. 1991 The dissipation-range spectrum and the velocity-derivative skewness in turbulent flows. *Phys. Fluids A* **3**, 992
- Smith, L.M. 1991 Turbulent Couette flow profiles that maximize the efficiency function. *J. Fluid Mech.* **227**, 509
- Malkus, W.V.R. & Smith, L.M. 1989 Upper bounds on functions of the dissipation rate in turbulent shear flow. *J. Fluid Mech.* **208**, 497

Invited Publications

- Smith, L.M. & Woodruff, S.L. 1998 Renormalization Group Methods in Turbulence. *Annual Reviews of Fluid Mechanics* **30**, 275

Submitted to Refereed Journals

- Sondak, D., Smith, L.M. & Waleffe, F. 2015 Optimal Heat Transport Solutions for Rayleigh-Bénard Convection, submitted to *J. Fluid Mech.*

Refereed Conference Proceedings

- Smith, L.M. & Rempel, M. 2007 Structure Formation in Rotating and Stratified Flows, Computational Physics and New Perspectives in Turbulence, accepted with revisions, IUTAM 2006 Proceedings, Springer-Verlag.
- Smith, L.M. 2001 Numerical Study of Two-Dimensional Stratified Turbulence, Advances in Wave Interaction and Turbulence, *Cont. Math.* **283**, eds. Milewski, P.A., Smith, L.M., Tabak, E.G., & Waleffe, F., Amer. Math. Soc., Providence, RI.

Technical Reports

- Smith, L.M. & Reynolds, W.C. 1991 Derivation of the $\bar{\mathcal{K}} - \bar{\mathcal{E}}$ model equations using the renormalization group method. *CTR Annual Research Briefs*.
- Smith, L.M. & Reynolds, W.C. 1990 Progress in understanding the renormalization group skewness and $\bar{\mathcal{K}} - \bar{\mathcal{E}}$ models. *CTR Annual Research Briefs*, 51.
- Smith, L.M. & Reynolds, W.C. 1989 Development of the renormalization group analysis of turbulence. *CTR Annual Research Briefs*, 81.
- Smith, L.M. & Reynolds, W.C. 1988 Renormalization group analysis of turbulence. *CTR Annual Research Briefs*, 29.
- Smith, L.M. 1985 A Hamiltonian formulation of the anelastic equations. *Proceedings of the Summer Program in Geophysical Fluid Dynamics* (Woods Hole Oceanographic Institute).

Honors

- Van Vleck Prize 2011-2015
- Fellow, American Physical Society, since 2008
- UW Vilas Associate Award, 2005-2007

Other Professional Activities

- Organizer of NSF-RTG workshop on Coherent and Turbulent Convection, Madison, WI, May 27-29, 2015.
- Organizer of an SIAM Mini-symposium on Modeling and Prediction of Geophysical Flows, SIAM Conference on Nonlinear Waves and Coherent Structures, Churchill College, Cambridge, UK, August 11-14, 2014.
- Co-organizer of an AIMS Mini-symposium on Waves and Convection, the 9th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, July 1 - 5, 2012.
- Associate Editor, 2002-2008, *Communications in Mathematical Sciences*
- Associate Editor, *Journal of Turbulence*

- Member, American Mathematical Society; American Physical Society, Division of Fluid Dynamics; Society for Industrial and Applied Mathematics
- Member, Mathematics Design Team, a WI state committee to make recommendations for strengthening state standards for High School Mathematics in partnership with Academic Diploma Project and Partnership for 21st Century Skills, 2007-2008
- Member, Madison Metropolitan School District Algebra Committee, 2003-2004
- Co-organizer of an AMS-IMS-SIAM Joint Summer Research Conference in Mathematical Sciences, *Dispersive Wave Turbulence*, held at Mount Holyoke College, South Hadley, MA, June 11-15, 2000.
- Co-organizer of A Network of Mentors in Mathematics (with Gloria Mari-Beffa), providing mentorship and mathematical projects for girls in Madison high schools and middle schools, 2004-2009
- Fellow, Geophysical Fluid Dynamics Summer Program, Woods Hole Oceanographic Institute. Research project: *a Hamiltonian formulation of the anelastic equations for use in meteorological and astrophysical contexts.*

Invited Lectures and Seminars

- July 2016, 11th AIMS Conference on Dynamical Systems, Differential Equations and Applications, mini-symposium on Classical and Geophysical Fluid Dynamics, Orlando, FL *TBA*.
- Septmeber 2015, Colloquium in the Department of Atmospheric and Oceanic Sciences, US-Madison. *Minimal Models for Precipitating, Turbulent Convection.*
- August 2015, International Congress on Industrial and Applied Mathematics, mini-symposium Mathematics of Climate: from the Tropics to Antarctica, Beijing, China. *Minimal Models for Precipitating, Turbulent Convection.*
- April 2015, PDE/Applied Math Seminar, Indiana University Bloomington. *Minimal Models for Precipitating, Turbulent Convection.*
- October 2014 Geophysical and Astrophysical Turbulence, Institute for Pure and Applied Mathematics, University of California, Los Angeles. *Minimal models for precipitating turbulent convection.*

- August 2014 Plenary lecture, SIAM Nonlinear Waves and Coherent Structures, Churchill College, Cambridge, UK. *Minimal models for precipitating turbulent convection.*
- November 2013 International Conference on Zonal Flows in Geophysical and Astrophysical Fluids, Research Institute for Mathematical Sciences, Kyoto University, Japan. *Generation of Zonal Jets by Three-Wave Near-Resonant Interactions.*
- April 2013 Widely Applied Mathematics seminar at the Harvard University, Cambridge, MA. *On the Spontaneous Generation of Inertia-Gravity Waves.*
- April 2013 Applied Mathematics Colloquium at the Massachusetts Institute of Technology, Cambridge, MA. *On the Spontaneous Generation of Inertia-Gravity Waves.*
- February 2013. Workshop on Geophysical Fluid Dynamics, The Mathematics Research Center, Oberwolfach, Germany. *On the Spontaneous Generation of Inertia-Gravity Waves.*
- October 2012 Colloquium at the University of Colorado. *Minimal models for precipitating organized convection.*
- July 2012. Mini-symposium on Recent Developments on Turbulence, the 9th AIMS Conference on Dynamical Systems, Differential Equations and Applications Orlando, Florida. *Aspect ratio effects on layer thickness in stratified turbulence.*
- May 2012. Pedagogical invited lecturer at the Workshop on Connections between Rotating, Stratified Turbulence and Climate: Theory, Observations, Experiments, and Models, NCAR, Boulder, CO. *Minimal models for precipitating organized convection.*
- April 2012. Mini-symposium: Insight into Geophysical Fluid Dynamics through Analysis and Computation at the Eighth International Conference on Scientific Computing and Applications, University of Nevada, Las Vegas. *Minimal models for precipitating organized convection.*
- January 2012. Colloquium at the Center for Atmosphere Ocean Science, Courant Institute of Mathematical Sciences, New York University. *Simplified moist 3D Boussinesq dynamics for the hurricane embryo.*
- July 2011. Geophysical Fluid Dynamics Summer Program, Woods Hole Oceanographic Institute, Woods Hole, MA. *A hierarchy of PDE reduced models for rotating stratified flows.*

- June 2011. Workshop on Applied Analysis and Applied PDE, University of Victoria. *Simplified moist 3D Boussinesq dynamics for the hurricane embryo.*
- June 2011. Workshop on Applied Analysis and Applied PDE, University of Victoria. *A hierarchy of PDE reduced models for rotating stratified flows.*
- May 2011. Mini-symposium on Waves in Stratified Flow at the SIAM Dynamical Systems Conference, Snowbird, UT. Generation of shear flows by three-wave interactions in stratified flows.
- May 2011. BIRS Workshop on Organized Tropical Convection and Large-scale Circulation: Theory, Modeling, and Observations, Banff Research Station, Banff, Canada. *Simplified moist 3D Boussinesq dynamics for the hurricane embryo.*
- Aug. 2010. Workshop on Mathematical Theory and Modelling in Atmosphere-Ocean-Science, The Mathematics Research Center, Oberwolfach, Germany.
- Feb. 2010. Workshop on Analysis and Computation of Incompressible Fluid Flow, Institute for Mathematics and Its Applications, University of Minnesota. *New PDE reduced models for geophysical flows.*
- Feb. 2010. Colloquium at Rensselaer Polytechnic Institute, Troy, NY *New PDE reduced models for geophysical flows.*
- Sept. 2009. Colloquium at the University of Michigan, Ann Arbor, MI, *Waves in the atmosphere and oceans.*
- July 2009. Invited lecture at Institut de Recherche sur les Phénomènes Hors Équilibre, CNRS, Marseille, France. *Waves and coherent structures in rotating and stratified flows.*
- April 2009. Workshop on Multiscale Modeling for the Tropics, Banff International Research Station for Mathematical Innovation and Discovery (BIRS), Banff, Alberta, Canada.
- July 2008. Principal Lecturer for the 2008 Summer School sponsored by the National Center for Atmospheric Research (NCAR/IMAGE) on Theory and Modeling in Geophysical Fluid Dynamics, Boulder, CO.
- April 2008. PIMS workshop Waves in the Atmosphere and Ocean, *Wave-vortical mode interactions in atmosphere-ocean flows.*
- February 2008. Keynote speaker for NCAR/Image workshop Turbulent Theory and Modeling, *Wave-vortical mode interactions in atmosphere-ocean flows.*

- April 2007. Workshop on Stochastic Dynamical Systems and Climate Modeling, Banff International Research Station for Mathematical Innovation and Discovery (BIRS), Banff, Alberta, Canada, *Reduced models for wave and vortical interactions in stochastically forced dispersive systems.*
- April 2006. The University of Chicago, Department of Mathematics, *Multi-scale coupling in rotating and stratified flows.*
- Jan. 2006. AGU Chapman Conference on Jets and Annular Structures in Geophysical Fluids, Savannah, Georgia, *A mechanism for the formation of jets from small-scale forcing of beta-plane flow.*
- Dec. 2004. The Courant Institute of Mathematical Sciences, Workshop on Large-Scale Turbulence in the Atmosphere and Ocean, *On near-resonances and symmetry breaking in rotating turbulence at moderate Rossby numbers.*
- Sept. 2004. SIAM Mini-Symposium Speaker, Conference on Nonlinear Waves and Coherent Structures, Orlando, *On near-resonances and symmetry breaking in rotating turbulence at moderate Rossby numbers.*
- Aug. 2004. Workshop on Fluid Turbulence, Cascade Dynamics: Fundamentals and Modeling, Santa Fe, *On near-resonances and symmetry breaking in rotating turbulence at moderate Rossby numbers.*
- July 2003. University of California, Los Angeles, workshop on Subgrid Scale Turbulence Methods for Geodynamo Simulations, *Large-scale, coherent structures from small-scale noise in rotating and stratified flows.*
- June 2003. The Center for Nonlinear Studies, Los Alamos National Laboratory, *Large-scale, coherent structures from small-scale noise in rotating and stratified flows.*
- May 2003. SIAM Mini-Symposium Speaker, Utah Dynamical Systems, Utah, *Approximate slow manifolds including the vertically sheared, horizontal flow modes.*
- April 2003. University of Minnesota, Department of Mathematics, Distinguished Women in Science lecture series, *Anisotropic turbulence in geophysical flows.*
- August 2002. The Mathematics Research Center, Oberwolfach, Germany, conference on Mathematical Theory and Modelling in Atmosphere-Ocean Science, *Stability of Rossby waves in the β -plane approximation.*
- July 2002. Department of Engineering Physics, University of Wisconsin, Madison, *Anisotropic turbulence.*

- March 2002. University of Maryland, College Park, *Energy transfer to large scales in rotating, stratified turbulence forced randomly at small scales.*
- Feb. 2002. University of Minnesota, The Institute for Mathematics Applications. *Slow manifolds in rotating, stratified flows.*
- June 2001. Ecole Centrale de Lyon, Laboratoire de Mecanique des Fluides et d'Acoustique. *The limits of validity of the quasi-geostrophic equations.*
- Dec. 2000. The University of Wisconsin Madison, Chaos and Complex Systems Seminar. *The generation of large-scale flows from small-scale turbulence in the earth's atmosphere and oceans.*
- June 2000. Dispersive Wave Turbulence Conference, Mount Holyoke College, South Hadley, MA. *Energy transfer to large scales in rotating and stratified turbulence forced randomly at small scales.*
- May 2000. The Institute for Theoretical Physics, University of California, Santa Barbara. *The generation of large-scale structures in wave-turbulence systems forced randomly at small scales.*
- October 1999. The University of Minnesota, Department of Aerospace Engineering and Mechanics. *The generation of 2D large scales in 3D rotating turbulence forced randomly at small scales.*
- December 1998. The University of Michigan, Department of Mathematics. *The generation of 2D large scales in 3D rotating turbulence forced randomly at small scales.*
- November 1998. The University of Wisconsin, Department of Mechanical Engineering. *Rotating Turbulence.*
- November 1998. The University of Wisconsin, Department of Atmospheric and Oceanic Sciences. *The generation of 2D large scales in 3D rotating turbulence forced randomly at small scales.*
- October 1998. The Courant Institute for Mathematics, New York University. *The generation of 2D large scales in 3D rotating turbulence forced randomly at small scales.*
- January 1997 and November 1996. The University of Wisconsin at Madison. *The crossover from two- to three-dimensional turbulence.*
- July 1996. EPFL Workshop on Turbulence Modeling and the Theory of Hydrodynamic Instability, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland. *Small-aspect-ratio 3D turbulence and the modeling of geophysical flows.*

- May 1996. The Massachusetts Institute of Technology. *The Crossover from two- to three-dimensional turbulence.*
- January 1996. ICASE, NASA Langley Research Center. *Forced rotating turbulence in small-aspect-ratio domains.*
- November 1995. The Department of Mechanical Engineering, Boston University, Boston. *Condensation in rotating small-aspect-ratio turbulence.*
- October 1995. The Department of Applied Physics, Columbia University, New York. *Condensation in rotating small-aspect-ratio turbulence.*
- October 1994. The Department of Mechanical Engineering, The University of California at Berkeley. *Finite-size effects in two-dimensional turbulence and the atmospheric spectrum.*
- August 1994. Los Alamos National Laboratory. *Finite-Size Effects in Two-Dimensional Turbulence and the Atmospheric Spectrum.*
- May 1993. The Department of Theoretical and Applied Mechanics, The University of Illinois. *The Modeling of Turbulent Flows Using The $\bar{K} - \bar{\epsilon}$ Equations.*
- April 1993. Department of Mechanical Engineering and Applied Mechanics, The University of Michigan. *The Modeling of Turbulent Flows Using The $\bar{K} - \bar{\epsilon}$ Equations.*
- April 1993. The Center for Fluid Dynamics, Brown University. *The Inverse Cascade to Structure Formation in Two-Dimensional Turbulence.*
- April 1993. Department of Mechanical Engineering, Yale University. *The Inverse Cascade to Structure Formation in Two-Dimensional Turbulence.*
- April 1993. Department of Mechanical and Aerospace Engineering, Rutgers University, *Two-dimensional turbulence in the zero-viscosity limit: an example of Gaussian turbulence.*
- March 1993. Department of Mathematics, The University of California at Irvine, *Two-dimensional turbulence in the zero-viscosity limit: an example of Gaussian turbulence.*
- October 1992. Mechanical and Aerospace Engineering Department, Princeton University. *Non-equilibrium modeling of turbulent flows.*
- March 1992. Department of Mechanical Engineering, Johns Hopkins University. *Fundamentals and applications of the renormalization group theory of turbulence.*

- March, 1992. ICASE, NASA Langley Research Center. *Fundamentals and applications of the renormalization group theory of turbulence.*
- February, 1992. Mathematics Department, Caltech University. *Fundamentals and applications of the renormalization group theory of turbulence.*
- February, 1992. Mathematics Department, University of Arizona at Tuscon. *Fundamentals and applications of the renormalization group theory of turbulence.*
- November 1991. Department of Mechanical Engineering, The University of Maryland at College Park. *Derivation of the $\bar{K} - \bar{\epsilon}$ model equations from renormalization group theory.*
- October 1991. Fluid Mechanics Series, The Levich Institute of the City College of New York. *Derivation of the $\bar{K} - \bar{\epsilon}$ model equations from renormalization group theory.*
- July 1991. Politecnico di Torino, Dipartimento di Ingegneria Aeronautica e Spaziale, Torino, Italy. *RNG and turbulence modeling.*
- May 1991 The von Karman Institute for Fluid Dynamics, Rhode-Saint-Genèse, Belgium. Lectures for the series New Approaches in the Description and Modeling of Turbulence, *Renormalization Group Theory and Turbulence Modeling.*
- August 1990. Summer Program at the Center for Turbulence Research. *The renormalization group method for deriving turbulence statistics and models.*
- April 1989. The Center For Turbulence Research. *Renormalization group analysis of turbulence.*
- October 1988. Fluid Mechanics Seminar, Stanford University. *Upper bound theory of turbulent shear flows.*

Current Post-Docs

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| A. Wetzel | Mathematics and AOS, partially supported by NSF AGS-1443325, starting August 2015. |
| C.N. Tzou | Mathematics, starting August 2015. |
| D. Sondak | Mathematics, Turbulence and unstable solutions of the rotating Boussinesq equations, partially supported by NSF-RTG 8/13-6/16. |

Previous Post-Docs

- G. Hernandez Mathematics, Analysis and modeling of rotating, stratified flows with and without moisture, partially supported by NSF-CMG 9/10-9/13; currently Assistant Professor at UNAM, Mexico.
- A. Boonkasame Mathematics, Wall-bounded convection, partially supported by NSF 9/10-9/13; Prince of Songkla University, Thailand, starting August 2015.
- J. Sukhatme Mathematics, Multi-scale modeling in rotating and stratified flows, supported by NSF-CMG 1/06-12/08; currently Assistant Professor, Center for Atmospheric and Oceanic Sciences, India Institute for Science, Bangalore, India.
- H. Lu Mechanical Engineering, Numerical simulation of horizontal and vertical mixing in a rotating and stratified channel, co-advised with Christopher Rutland, supported by NSF-CTS 6/07-8/08; currently Associate Professor at Huazhong University of Science and Technology, China.

Current Students

- T. Edwards Mathematics, Minimal Models for Investigating the Influence of Latent Heat Release on Mid-Latitude Dynamics, co-advised by Sam Stechmann, PhD expected May 2019.

Students Graduated

- Q. Deng Mathematics, Models of moist dynamics for the atmosphere, PhD August 2012, postdoctoral fellow at Courant Abu Dhabi.
- L. Wang Mathematics, Detailed analysis and simulations of wave interactions in β -plane and rotating flows, PhD August 2011, Epic Systems Corporation.
- M. Rimmel Mathematics, Reduced models and structure formation in the rotating shallow water and rotating Boussinesq equations, PhD May 2010, VIGRE postdoctoral fellow, University of California, Davis.

- H. Lu Mechanical Engineering, Large-eddy simulation of strongly rotating turbulence, co-advised by Christopher Rutland, PhD May 2007; postdoctoral fellow at the St. Anthony Falls Laboratory, University of Minnesota.
- C. McKay Physics, The effects of stratification on the wind-driven ocean circulation, PhD July 2005; currently Associate Professor of Physics, Marietta College, Marietta, Ohio.
- Y. Lee Mathematics, Anisotropic energy transfer in beta-plane and rotating flows, PhD Dec. 2003; 2004-2006 Pacific Institute of Mathematical Sciences (PIMS) post-doc at Simon Fraser University, Vancouver, Canada; since 2006 Financial Engineer at QuIC Financial Technologies Inc.