Jared P. Whitehead
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Education/Positions

- **B.S. Mathematics**, Brigham Young University, April 2006 (Magna Cum Laude), GPA=3.92/4.0
  - Graduate with University Honors
- **PhD, Applied and Interdisciplinary Mathematics**, University of Michigan, January 2012, GPA=8.075/8.0
  - Academic Advisors: Charles R. Doering, (734) 936-2913, doering@umich.edu.
    Richard B. Rood, (734) 647-3530, rbrood@umich.edu.
    Christiane Jablonowski, (734) 763-6238, cjablono@umich.edu.
- Post-doctoral research scientist, Center for Nonlinear Studies post-doctoral scholar, Los Alamos National Laboratory: February 2012-October 2013
  - Supervisor: Beth A. Wingate wingate@lanl.gov.
- Assistant Professor, Department of Mathematics, Brigham Young University: October 2013-present

Research Interests: I am interested in the dynamics of fluid flow. I use numerical simulations (and the available tools of numerical analysis), asymptotics including the separation of time-scales, the calculus of variations, and other methods inherent to mathematical physics to gain physical insight into the dynamic interactions thought to describe the evolution of a fluid. Thus far my research has focused on three different sub-topics of what is commonly referred to as geophysical fluid dynamics: 1) Rigorous bounds on the transport of heat in, and numerical simulation of, idealized convective processes. 2) Analysis of the accuracy and reliability of climate models meant to model the oceans and atmosphere. 3) Verification and 'stability' of reduced geophysical models.

Refereed Publications

In preparation:

1. *The impact of slippery boundaries on the dynamics of internal heating driven convection at infinite Prandtl number.* J. P. Whitehead (Phyiscs of Fluids, 2014).
2. *Persistently logarithmic: a bound on the vertical transport of heat in Rayleigh-Bénard convection at infinite Prandtl number with mixed thermal boundary conditions*. J. P. Whitehead and R. Wittenberg (Journal of Mathematical Physics, 2013).
3. *The separation of three distinct time scales in the rotating, stratified Boussinesq equations: Variations from Quasi-Geostrophy*. J. P. Whitehead, T. Haut, and B. A. Wingate (Communications in Mathematical Phsyics, 2013).

Submitted:

4. *Determining The Effective Resolution of Advection Schemes. Part I: Dispersion Analysis*. J. Kent, J. P. Whitehead, C. J. Jablonowski, and R. B. Rood (Journal of Computational Physics, 2013).
5. *The influence of fast waves and fluctuations on the evolution of the 'slow manifold'.* J. P. Whitehead and B. A. Wingate. (Journal of Fluid Mechanics, 2013).
6. *Potential Vorticity: a diagnostic tool for General Circulation Models.* J. P. Whitehead, C.

Jablonowski, J. Kent, and R. B. Rood. (in revision for publication in Quarterly Journal of the Royal Meteorological Society, 2013).

Published:

7. *A bound on the vertical transport of heat in the `ultimate' state of slippery convection at large Prandtl numbers.* X. Wang and J. P. Whitehead. Journal of Fluid Mechanics, Vol. 729, 103--122 (2013).
8. *Downscale Cascades in Tracer Transport Test Cases: An Intercomparison of the Dynamical Cores in the Community Atmosphere Model.* J. Kent, C. Jablonowski, J. P. Whitehead, and R. B. Rood. Geoscientific Model Development, Vol 5, 1517--1530 (2012).
9. *Rigid bounds on heat transport by a fluid between slippery boundaries.* J. P. Whitehead and C. R. Doering. Journal of Fluid Mechanics, Vol 707, 241--259 (2012).
10. *Assessing tracer transport algorithms and the impact of vertical resolution in a finite-volume dynamical core.* J. Kent, C. Jablonowski, J. P. Whitehead, and R. B. Rood. Monthly Weather Review, Vol 140, No. , 1620-1638 (2012).
11. *The ultimate regime of two-dimensional Rayleigh-Benard convection with stress-free boundaries.* J. P. Whitehead and C. R. Doering. Physics Review Letters, Vol. 106, 244501,p1-p4 (2011).
12. *Internal heating driven convection at infinite Prandtl number.* J. P. Whitehead and C. R. Doering. Journal of Mathematical Physics, Vol. 52, 093101, 11 pages (2011).
13. *A stability analysis of divergence damping on a latitude-longitude grid.* J. P. Whitehead, C. Jablonowski, R. B. Rood, and P. H. Lauritzen. Monthly Weather Review, Vol. 139, No. 9, 2976—2993 (2011).
14. *Asymptotic values, pre-poles, and periodic points.* J. P. Whitehead and L. Bakker. International Journal of Bifurcations and Chaos, Vol. 20, No 4 (2010).

Other Publications

1. *Spontaneous formation of columnar vortices* (November 2012) APS Gallery of Fluid Motion, Fluid Dynamics Video for APS DFD 2012 meeting (http://arxiv.org/abs/1210.3620).
2. *Topics in geophysical fluid dynamics* (January 2012) Phd Dissertation, University of Michigan.
3. *Topological bifurcations of Julia sets* (April 2006) Brigham Young University Honors Thesis.

Selected Presentations (invited presentations in bold)

1. ***Of logarithms and exponents: convection at infinite Prandtl numbers with mixed thermal boundary conditions,*** Analysis of Fluids and Related Topics, Princeton University, Princeton, NJ (September 2013).
2. ***Asymptotics and the slow manifold: how balanced flow interacts with fast waves,*** Atmosphere Ocean Science Student Seminar, Courant Institute of the Mathematical Sciences, NYU, New York, NY, USA (September 2013).
3. ***In search of the 'Ultimate' state of Rayleigh-Benard convection,*** Applied Mathematics Laboratory Seminar, Courant Institute of the Mathematical Sciences, NYU, New York, NY, USA (September 2013).
4. *Asymptotically reduced equations in geophysical fluid dynamics and the relationship between the 'slow' manifold and the attracting set,* Mathematics Research Communities: Regularity Problems for Nonlinear Partial Differential Equations Modeling Fluids and Complex Fluids, Snowbird, UT, USA (June 2013).

5. *Potential Vorticity Anomalies: Dynamic or Numerical Artifact?,* SIAM Conference on Mathematical & Computational Issues in the Geosciences, Padua, Italy (June 2013).
6. *Asymptotic limits of strong stratification and rapid rotation in the Boussinesq equations,* 33rd Annual CNLS Conference: The Oceans and Turbulence, Santa Fe, NM, USA (June 2013).
7. *Approaching the limit of strong rotation for the rotating, stratified Boussinesq system*, SIAM Conference on Application of Dynamical Systems, Snowbird, UT, USA (May 2013).
8. ***In search of the ultimate state of slippery Rayleigh-Benard convection**,* University of Missouri Mathematics Department Colloquium, Columbia, MO, USA (January 2013).
9. *Approaching the limit of strong rotation for the rotating, stratified Boussinesq equations,* APS Division of Fluid Dynamics Meeting, San Diego, CA, USA (November 2012).
10. ***In search of the ultimate state of slippery Rayleigh-Benard convection**,* Brigham Young University Mathematics Department Colloquium, Provo, UT, USA (November 2012).
11. *Potential Vorticity: A diagnostic tool for general circulation models,* Partial Differential Equations on the Sphere, Cambridge, UK (September 2012).
12. *The Ultimate State of Two-dimensional Rayleigh Benard Convection between Free-Slip Fixed-Temperature Boundaries*, Los Alamos Stellar Hydrodynamics Workshop, Santa Fe, NM, USA (April 2012).
13. *The Ultimate State of Two-dimensional Rayleigh Benard Convection between Free-Slip Fixed-Temperature Boundaries*, APS Division of Fluid Dynamics Meeting, Baltimore, MD, USA (November 2011).
14. ***Bounds on Heat Transport for Fixed Flux Thermal Boundary Conditions at Infinite Prandtl Number***, SIAM Partial Differential Equations Meeting, San Diego, CA, USA (November 2011).
15. ***The Ultimate State of Two-dimensional Rayleigh Benard Convection between Free-Slip Fixed-Temperature Boundaries***, Los Alamos National Laboratory, Center for Nonlinear Studies Seminar, Los Alamos, NM, USA (October 2011).
16. *Internal heating driven convection at Infinite Prandtl number*, Incompressible Fluids, Turbulence and Mixing, Carnegie Mellon University, Pittsburgh, PA, USA (October 2011).
17. ***Bounds on the turbulent transport of heat driven by an internal heat source***, International Congress on Industrial and Applied Mathematics, Vancouver, BC, Canada (July 2011).
18. *Bounds on the turbulent transport of heat at infinite Prandtl number with no-slip boundaries* (March 2011), Midwest PDE, Urbana-Champaign, IL, USA.
19. *Bounds on the transport of heat in Rayleigh Benard convection* (February 2011), University of Michigan student AIM seminar, Ann Arbor, MI, USA.
20. *A generalized Hardy-Rellich inequality and improved bounds for convection driven by internal heating* (November 2010), University of Michigan SIAM Student Conference, Ann Arbor, MI, USA.
21. *A stability analysis of divergence damping on a latitude-longitude grid* (August 2010), Partial Differential Equations on the Sphere, Pottsdam, Germany.
22. *The Mathematics of climate change* (October 2008 and October 2009), Student applied and interdisciplinary mathematics seminar, University of Michigan, Ann Arbor, MI, USA.
23. *Functional representation of families of minimal surfaces* (March 2005) Intermountain Sectional Meeting of the Mathematical Association of America, Pocatello, ID, USA.
24. *Topological bifurcations of Julia sets* (March 2005 and March 2006) Brigham Young University Spring Research Conference, Provo, UT, USA.

Posters (1st author only)

1. *Evaluating the impact of dissipative subgrid-scale mixing processes in the dynamical cores of NCAR's Community Atmosphere Model,* DOE-BER PI meeting, Washington D.C., USA (September 2011).
2. *Potential Vorticity: a diagnostic tool for General Circulation Models*, Michigan Geophysical Union student poster competition, Ann Arbor, MI, USA (March 2011).
3. *Divergence damping: is additional diffusion good for stability?,* Michigan Geophysical Union student poster competition, Ann Arbor, MI, USA (March 2010).

Mini-Symposia Organized

1. *Regularity Problems for Nonlinear Partial Differential Equations Modeling Fluids and Complex Fluids* (20 speakers, co-organize with J. Bedroissian, T. K. Wong, and H. Jia), Joint Mathematics Meetings, Baltimore, MD, USA (January 2014).
2. *The use of test cases in the development and improvement of dynamical cores* (4 speakers, co-organize with J. Kent), SIAM Conference on Mathematical and Computational Issues in the Geosciences, Padua, Italy (June 2013).
3. *Numerical investigations of convection at high Rayleigh numbers* (4 speakers, co-organize with D. Goluskin), SIAM Conference on Mathematical and Computational Issues in the Geosciences, Padua, Italy (June 2013).
4. *Separation of Scales in Geophysical Fluid Dynamics* (4 speakers, co-organize with T. Haut), SIAM Conference on the Application of Dynamical Systems, Snowbird, UT, USA (May 2013).

Workshops Attended as participant (not organizer)

- Mathematics Research Communities: Regularity Problems for Nonlinear Partial Differential Equations Modeling Fluids and Complex Flows, Snowbird, UT, USA (June 2013).
- Workshop on 'Analysis and Computation of Incompressible Fluid Flow', Institute for Mathematics and its Applications (February 2010).
- Workshop on Analysis of Fluid Stability, University of Edinburgh (June 2009), primary organizers: Susan Friedlander, Rich Kerswell & Jacques Vanneste.
- SIAM Conference on Applications of Dynamical Systems (May 2009).
- Workshop on Reducing the Uncertainty in the Prediction of Global Warming, Institute for Advanced Studies, Hebrew University (January 2009), primary organizers: Isaac Held & Eli Tziperman.
- MSRI 'The Mathematics of Climate Change' (July 2008), primary organizers: Chris Jones & Mary Lou Zeeman.
- NCAR ASP 'Summer Colloquium on Numerical Techniques for Global Atmospheric Models' (June 2008), primary organizers: Christianne Jablonowski & Peter Lauritzen.
- Lipschitz Lecture at the Hausdorff Center for Mathematics, University of Bonn, Germany (April-May 2007). "Advection, Convection and Turbulent Transport of Heat, Mass and Momentum," Charles R. Doering.

Academic Honors, Grants etc.

- **National Science Foundation Postdoctoral Research Fellowship --** Florida State University (X. Wang & M. Gunzburger) -- declined for current position.
- *Asymptotic scaling of heat transport in infinite Prandtl number fluids at very high resolution*., Co-PI, National Science Foundation Teragrid (XSEDE) award TG-CTS 110010.

- 2nd Place Michigan Geophysical Union Poster competition, March 2010.
- **Orson Pratt Award**, April 2005 (Outstanding Senior in Mathematics Department, Brigham Young University).
- **Session Winner** for the Spring Research Conference, March 2006, Brigham Young University.

Membership in Professional Organizations

- Society for Industrial and Applied Mathematics (SIAM)
- American Physical Society (APS)
- American Mathematical Society (AMS)

Journals Refereed for

- Physics Letters A
- Proceedings of the Royal Society A
- Journal of Mathematical Physics
- Communications in Mathematical Physics
- Physical Review E
- Physical Review Letters

Non-academic Work Experience

MIT Lincoln Laboratories Summer Internship: May 2006-August 2006.
Supervisor: Dale G. Fried (781) 981-6806, dgf@ll.mit.edu.

National Security Agency: Director's Summer Program, Summer 2005:
Applications of the Calculus of Variations and Numerical Methods in Matlab

Teaching Experience

- **Graduate Student Instructor: delivered lectures, held office hours, graded homework and assisted in grading uniform exams**
  - Calculus I (MATH 115), University of Michigan Fall 2007.
  - Calculus I (MATH 115), University of Michigan Winter 2007.
  - Pre-Calculus (MATH 105), University of Michigan Fall 2006.
- **Graduate Student Instructor: delivered technology based lectures, held office hours, graded homework and assisted in grading uniform exams**
  - Multivariable Calculus (MATH 215), University of Michigan Fall 2008.
  - Elementary Linear Algebra (MATH 343), Brigham Young University Winter 2006.
- **Grader: Graded homework and occasionally assist grading quizzes/mid-terms**
  - University of Michigan:
    - Advanced Ordinary Differential Equations (MATH 558: Fall 2011, 2010, 2009).
    - Methods of Applied Math II: Asymptotic Analysis (MATH 557: Winter 2011, 2010).
    - Stochastic Processes (MATH 526: Fall 2011).
  - Brigham Young University: Calculus I, Multivariable Calculus, Introduction to Analysis, Elementary Linear Algebra.