Mark R. Petersen

Contact Information

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Research Interests

Investigations of geophysical and astrophysical flows using reduced equations and numerical models; quasi-geostrophic turbulence; planetary formation in protoplanetary disks; numerical methods for parallel climate models; education in science and engineering

Education

Ph.D. Candidate, Applied Mathematics (expected graduation: December 2004) GPA:3.97
University of Colorado at Boulder
Dissertation Topic: Study of the Slanted Quasi-Geostrophic Regime and Protoplanetary Disks
Advisors: Keith Julien (Applied Math), Jeff Weiss (PAOS), Glen Stewart (LASP)

M.S., Atmospheric and Oceanic Science, 2002, GPA:3.97
University of Colorado at Boulder

M.S., Mathematics and Statistics, 2000, GPA:3.94
University of Nebraska-Lincoln

B.S., Environmental Engineering, 1995, GPA:3.84
University of Nebraska-Lincoln

Professional Experience

Graduate student researcher and instructor — **2000 - present**
University of Colorado-Boulder, Department of Applied Mathematics
- Created 3D pseudo-spectral numerical model of slanted quasi-geostrophic regime to investigate vortex merger and alignment, energy cascade, and vortex formation.
- Investigation of baroclinic instabilities, Rossby waves, and vortices that affect planetary formation in protoplanetary disks. Created 2D pseudo-spectral numerical model on an annulus.
- Instructor, Differential Equations and Linear Algebra.
- Grader and substitute lecturer for graduate fluid dynamics, graduate atmospheric dynamics.

Mentor and consultant for undergraduate scientist program — **2002 - present**
National Center for Atmospheric Research
- Programming tutor and consultant in Matlab and Fortran for NCAR's Significant Opportunities in Atmospheric Research and Science (SOARS) program. (25 participants)
- Mentor in NCAR's Climate Change Research Section, with Warren Washington
  2002: 3D visualization of climate model output
  2003: Wavelet correlations of NCEP reanalysis and climate model output.
- Research in Bachelors and PhD degrees conferred to underrepresented minorities and women in science and engineering.

Reviewer and proofreader of atmospheric science texts — **2003 - present**
- Proofread problems and solutions manual for James R. Holton, *An Introduction to Dynamic Meteorology, 4th ed*, all chapters.
- Reviewed and proofread *A Climate Modelling Primer, 3rd ed* by K. McGuffie and A. Henderson-Sellers, two chapters.

Graduate student researcher and instructor — **1998 - 2000**
University of Nebraska-Lincoln, Department of Mathematics
- Created a numerical model of flow though a reactive porous media.
- Instructor for intermediate algebra, college algebra, mathematics for elementary school teachers, and calculus recitations.

Project Engineer, Air Pollution Control Systems **1996 - 1998**
U.S. Filter/RJ Environmental, San Diego, CA

- Responsible for Emergency Chlorine Scrubber product line, including design, fabrication details, and installation.
- Trained five new engineers.
- Designed packed-tower and activated carbon odor control systems.

HONORS AND AWARDS

- NSF VIGRE Graduate Student Fellowship, Spring 2002 to Fall 2004
- NASA Summer School for High Performance Computational Earth and Space Sciences
  Goddard, Maryland, July 7 to 25, 2003
- Helmholtz Institute for Supercomputational Physics
  Scientific Supercomputing in Climate Research
  Potsdam, Germany, August 26 to September 20, 2002
- CU Engineering Excellence Fund co-author, resulted in the successful acquisition of a $20,000 grant to renovate the Applied Mathematics Department's computer facility.

PUBLICATIONS

Petersen, M.R.: 2004, Musical analysis and synthesis using Matlab. *College Mathematics Journal,* accepted December 2003.

Windham, T., B. Kraus, and M.R. Petersen: 2004, Striving Towards Equity; Underrepresented Minorities and Women in Natural Sciences and Engineering. *NSF Alliances for Graduate Education and the Professoriate (AGEP), January 2004 meeting*, also submitted to Science.

J.D. Logan, M.R. Petersen, and T.S. Shores: 2002, Numerical study of reaction-mineralogy-porosity changes in porous media, *Applied Mathematics and Computation*, **127**, 149-164.

Rinkol, M., M.R. Petersen, D.D. Schulte, S.B. Verma and D.P. Billesbach: 2000, A review of the Gaussian plume model in the context of the agricultural industry. Paper MC 00-118. *Mid-Central Meeting of the ASAE*, April 28-29. 19 p.

Honold, C.U., A. Gronauer, H. Stanzel, M.R. Petersen: 1995, Computergestützte Flüssigmistausbringsysteme - Ergebnisse aus Prüfstandsversuchen zur Längs- und Querverteilgenauigkeit. (Computer based Liquid manure distribution system: Performance of a test rig for length- and cross-wise accuracy) *Landtechnik (Agricultural Engineering)* **50** (5), 276-283.

Schulte, D.D., R.E. Eigenberg and M.R. Petersen: 1994, Evaluation of waste management decision making tools, *Great Plains Agricultural Council Publication*, **151**, 154-160.

PAPERS IN PREPARATION

Petersen, M.R., K. Julien, and J.B. Weiss: Numerical experiments of the slanted quasi-geostrophic equation.

Petersen, M.R., G. Stewart, and K. Julien: A simplified model for Rossby waves in protoplanetary disks.

PRESENTATIONS

A Study of Geophysical and Astrophysical Flows using Numerical Models
Comprehensive Examination, Applied Mathematics Dept, CU-Boulder, December 11, 2003

Numerical Methods in Climate Modeling
Water Resources Group Seminar, Civil Engineering Dept., CU-Boulder, October 22, 2003
SIAM Student Seminar, Applied Mathematics Dept, CU-Boulder, September 23, 2003
Graduate Student Seminar, CU Program in Atmospheric and Oceanic Sciences, Sept. 19, 2003

A Parallel Geophysical Fluids Model
NASA Summer School for High Performance Computational Earth and Space Sciences,
Goddard, Maryland, July 24, 2003

Verification of a Quasi-Geostrophic Model
Dynamical Systems Seminar, Applied Mathematics Dept, CU-Boulder, March 6, 2003

Kolmogorov's Two-Thirds Law and the Energy Spectrum

Graduate Student Seminar, CU Program in Atmospheric and Oceanic Sciences, January 31, 2003

Atmospheric Observations of Kelvin, Rossby, and Inertia-Gravity Waves
Graduate Student Seminar, CU Program in Atmospheric and Oceanic Sciences, October 15, 2002

A Suite of Quasi-Geostrophic Equations
Helmholtz Institute for Scientific Supercomputing in Climate Research,
Potsdam, Germany, September 5, 2002

Climate Model Visualization using Matlab (90 minute lecture)
Helmholtz Institute for Scientific Supercomputing in Climate Research,
Potsdam, Germany, September 6, 2002

The Slanted Quasi-Geostrophic Equation
Vigre Symposium, Applied Mathematics Dept, CU-Boulder, July 26, 2002

History of the Navier-Stokes Equation
Graduate Student Seminar, CU Program in Atmospheric and Oceanic Sciences, April 24, 2002
SIAM Student Seminar, Applied Mathematics Dept, CU-Boulder, October, 2002

Atmospheric Dynamics and Numerical Weather Prediction
Departmental Colloquium, University of Nebraska-Lincoln Mathematics Dept., January 2, 2002
SIAM Student Seminar, Applied Mathematics Dept, CU-Boulder, January 17, 2002
Dynamical Systems Seminar, Applied Mathematics Dept, CU-Boulder, January 31, 2002

Computer Skills

- Languages: Extensive experience in Fortran 77, Fortran 90, and Matlab. Experience with MPI, Open MP, c and python
- Algorithms: Spectral and pseudospectral methods, fast Fourier transforms, Runge-Kutta methods.

Educational Outreach

- Fundamentals of Engineering (FE) Examination Mathematics review instructor
  April 2003, October 2003.
- Author of Atmospheric Dynamics computer lab for APPM 2350, vector calculus, March 2002.
- Mathematics and Music Presentation: Vibrating Strings, pitch, and the major scale.
  Fourier Series and Boundary Value Problems, APPM 4350, guest lecturer, November 18, 2002
  Summer Institute for Secondary Mathematics Teachers, July 2002, July 2001
  CU Women in Engineering Day, March 2, 2002
  CU High School Honors Institute, July 2001
  CU Engineering Open House, Oct 2000, Oct 2001
- Boulder County Science Fair Judge, February 6, 2003
- Moderator, National Ocean Sciences Bowl
  Cooperative Institute for Research in Environmental Science (CIRES), Feb 2001, Feb 2002.