

# SHANE R. KEATING

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School of Mathematics and Statistics  
University of New South Wales  
Sydney, NSW 2052, Australia

**Born:** July 10, 1980 (Republic of Ireland) — **Citizenship:** USA and Republic of Ireland  
**Research Interests:** Turbulent mixing; satellite oceanography; data assimilation; parameterization

## Employment and Education

- **Lecturer**—University of New South Wales, Sydney, Australia  
*Department of Mathematics & Statistics: Feb 2013–Present*
- **Assistant Research Scientist**—Courant Institute of Mathematical Sciences, New York  
*Center for Atmosphere-Ocean Science: Aug 2010–Jan 2013 (Advisor: Shafer Smith)*
- **Postdoctoral Researcher**—Courant Institute of Mathematical Sciences, New York  
*Center for Atmosphere-Ocean Science: Aug 2008–Jul 2010 (Advisors: Shafer Smith, Pete Kramer)*
- **Ph.D. in Physics**—University of California San Diego (USA)  
*Department of Physics: Sep 2003–Jun 2008 (Advisor: Patrick Diamond)*
- **B.A. in Theoretical Physics**—Trinity College Dublin (Ireland)  
*Department of Physics and Department of Mathematics: Sep 1998–Jun 2002*

## Awards and Fellowships

- **Vice-Chancellor’s Award for Teaching Excellence.** For Outstanding Contributions to Student Learning. University of New South Wales. (Dec 2016)
- **Graduate Fellow, Woods Hole Oceanographic Institute.** Summer School on Geophysical Fluid Dynamics. (Summer 2006)
- **Graduate Fellow, Department of Mathematics and Theoretical Physics, Cambridge.** Summer School on Geophysical and Environmental Fluid Dynamics. (Sept 2005)
- **Academic Excellence Award, Department of Physics, UC San Diego.** (June 2005)
- **Gold Medalist, Trinity College Dublin.** (Jun 2002)
- **J.L. Synge Prize, Department of Mathematics, Trinity College Dublin.** (Jun 2001)
- **Foundation Scholarship, Trinity College Dublin.** (Apr 2000–Jun 2002)

## Funding

**Total funding received:** AU \$899,000 (US \$693,000).

- **UNSW Faculty Research Grant.** Title: *Unravelling ocean filaments, fronts, and vortices at kilometre scales.* AU \$5,000. (Jan–Dec 2017).
- **UNSW Silverstar Research Award.** Title: *Unravelling the submesoscale with super-resolved satellite observations of the ocean.* AU \$35,000. (Jan–Dec 2016). With Moninya Roughan (UNSW) and Patrice Klein (Ifremer)

- **UNSW Faculty Research Grant.** Title: *Untangling the submesoscale with enhanced satellite observations of the ocean.* AU \$5,000. (Jan–Dec 2015).
- **UNSW Faculty Research Grant.** Title: *Radical methods for super-resolving satellite observations of the ocean.* AU \$5,000. (Jan–Dec 2014).
- **UNSW Early Career Research Grant.** Title: *Topological, statistical, and signal-theoretic methods for identifying Lagrangian coherent structures in the East Australian Current.* With Moninya Roughan (UNSW) and Gary Froyland (UNSW). AU \$5,750. (Jan–Dec 2013).
- **National Science Foundation Research Grant (US).** Title: *Optimizing the utility of satellite altimetry for diagnosing lateral stirring and mixing in the upper ocean (OCE-0962054).* US \$650,000. With Shafer Smith (Courant). (Aug 2010–Jul 2013)

## Research Teams

- **NASA Science Team, Surface Water Ocean Topography Mission.** Title: *Fluxes of heat, carbon, and oxygen at SWOT scales.* Lead Investigators: K. Shafer Smith (NYU) and Ryan Abernathy (Columbia). (Jan 2016–Jul 2020)

I am a member of the NASA Science Team for the Surface Water Ocean Topography (SWOT) mission to be launched in 2020.

- **Co-PI, R/V Investigator.** Title: *The whole enchilada: from production to predation in Tasman Sea ecosystems.* Chief Scientist: Iain Suthers (UNSW). (Sept 2017)

Responsibilities: Submesoscale dynamics; at sea I will lead the analysis of satellite observational data (SST, MODIS, ocean colour) to identify and track submesoscale features and work with Co-PI Moninya Roughan (UNSW) to develop the daily sampling plan using GPS-tracked drifters, CTD, ADCP, and Triaxus data.

- **Physical Oceanographer, R/V Investigator.** Title: *Submesoscale processes — Billows and eddies along the productive shelf by the East Australian Current.* Chief Scientist: Iain Suthers (UNSW). (June 2015)

Responsibilities: Submesoscale eddy detection and tracking; Sea-surface temperature forecasts; Deployment of GPS-tracked drifters and CTD; Analysis of ADCP and Triaxus data.

## Refereed Publications

**Bibliometrics:** Citations = 130. H-index = 4. (*Scopus*, 10 January 2017, Author ID: 23025174100)  
ORCID: [orcid.org/0000-0002-6817-925X](https://orcid.org/0000-0002-6817-925X)

16. Jet-topography interactions affect energy pathways in the deep Southern Ocean.  
A. Barthel, S. Waterman, A. McC. Hogg and **Shane R. Keating** (2017)  
*Journal of Physical Oceanography* (Accepted)
15. A tale of two eddies: The bio-physical characteristics of two contrasting cyclonic eddies in the East Australian Current.  
M. Roughan, **Shane R. Keating**, A. Schaeffer, P. Cetina Heredia, D. Griffin, R. Robertson, C. Rocha, I.M. Suthers (2017)  
*Journal of Geophysical Research–Oceans* (Accepted)

14. Eulerian and Lagrangian characterization of two counter-rotating submesoscale eddies in a western boundary current.  
A. Mantovanelli, **S.R. Keating**, M. Roughan, L.R. Wyatt, A. Schaeffer (2017)  
*Journal of Geophysical Research–Oceans* (In revision)
13. A regime diagram for ocean geostrophic turbulence  
Andreas Klockner, David P. Marshall, **Shane R. Keating**, and Peter L. Read (2015)  
*Quarterly Journal of the Royal Meteorological Society* 142 (699): 2411-2417
12. Pairwise surface drifter dispersion in the Western Pacific Sector of the Southern Ocean  
Erik van Sebille, Stephanie Waterman, Alice Barthel, Rich Lumpkin, **Shane R. Keating**, Chris Fogwill, and Chris Turney (2015)  
*Journal of Geophysical Research–Oceans* 120: 6769-6781.
11. Upper ocean flow statistics estimated from superresolved sea-surface temperature images  
**Shane R. Keating** and K. Shafer Smith (2015)  
*Journal of Geophysical Research–Oceans* 120(2): 1197-1214
10. Diagnosing ocean stirring: Relative dispersion and finite-time Lyapunov exponents  
Darryn W. Waugh, **Shane R. Keating** and Mei-Lin Chen (2012)  
*Journal of Physical Oceanography* 42(7): 1173-1185
9. New methods for estimating ocean eddy heat transport using satellite altimetry  
**Shane R. Keating**, Andrew J. Majda and K. Shafer Smith (2012)  
*Monthly Weather Review* 140(5): 1703–1722
8. Diagnosing lateral mixing with virtual tracers: Spatial and temporal resolution dependence  
**Shane R. Keating**, K. Shafer Smith and Peter R. Kramer (2011)  
*Journal of Physical Oceanography* 41(8): 1512–1534
7. Patterns of convection in solidifying binary solutions  
**Shane R. Keating**, Edward A. Spiegel and M. Grae Worster (2011)  
*Geophysical and Astrophysical Fluid Dynamics* 105: 304-328
6. Homogenization and mixing measures for a replenishing passive scalar field  
**Shane R. Keating**, Peter R. Kramer and K. Shafer Smith (2010)  
*Physics of Fluids* 22: 075105
5. Homogenization theory for a replenishing passive scalar field  
Peter R. Kramer and **Shane R. Keating** (2009)  
*Chinese Annals of Mathematics* 50(5): 632–644
4. On cross-phase and the quenching of turbulent diffusion of magnetic fields in 2D  
**Shane R. Keating**, Lara J. Silvers and Patrick H. Diamond (2008)  
*Astrophysical Journal Letters* 678: 137–140
3. Turbulent resistivity in wavy two-dimensional magnetohydrodynamic turbulence  
**Shane R. Keating** and Patrick H. Diamond (2008)  
*Journal of Fluid Mechanics* 595: 173–202
2. Turbulent diffusion of magnetic fields in 2D MHD turbulence with stable stratification  
**Shane R. Keating** and Patrick H. Diamond (2007)  
*Physical Review Letters* 99: 224502
1. Waiting time distributions in financial markets (2002)  
Lorenzo Sabatelli, **Shane R. Keating**, Jonathan Dudley and Peter Richmond  
*European Physical Journal B*, 27: 273

## Non-refereed Publications

3. The effect of surface buoyancy gradients on oceanic Rossby wave propagation.  
Xiao Xiao, K.Shafer Smith and **Shane R. Keating** (2015)  
<http://arxiv.org/abs/1407.8255>
2. Wavy magnetohydrodynamic turbulence  
**Shane R. Keating** (2008)  
*Doctoral Thesis, University of California San Diego: 1-183*
1. Patterns of convection in mushy layers  
**Shane R. Keating** (2007)  
*Woods Hole Oceanographic Institution Technical Report 2007-02: 189-203*

## Conferences and workshops (selected)

- Jan 2017: Banff International Research Station, Alberta, Canada  
*Workshop of Transport in Unsteady Flows (invited speaker)*
- Dec 2016: NASA Jet Propulsion Laboratory, Pasadena, CA  
*Workshop on Cal/Val for Surface Water Ocean Topography mission (speaker)*
- Dec 2016: Australian Bureau of Meteorology, Melbourne, VIC  
*Workshop on Data Assimilation (invited speaker)*
- Feb 2016: AGU Ocean Sciences Meeting, New Orleans, LA  
*Session on Oceanic Energy Pathways: From the Global Circulation to the Submesoscale (speaker)*
- Feb 2016: ANZIAM Annual Conference, Canberra, ACT  
*Stochastic methods for interpolating satellite imagery (speaker)*
- Nov 2015: Australian Bureau of Meteorology, Melbourne, VIC  
*Workshop on Satellite Oceanography (speaker)*
- Jul 2015: AMOS National Conference, Brisbane, QLD  
*Session on Ocean Mixing (speaker)*
- Oct 2014: Institute for Pure and Applied Mathematics, UCLA, Los Angeles, CA  
*Workshop on Turbulent Transport and Mixing (invited speaker)*
- Feb 2014: AGU Ocean Sciences Meeting, Honolulu, HI  
*Session on Frontiers of Oceanographic Data and Methods (speaker)*
- Feb 2014: ANZIAM Annual Conference, Rotorua, New Zealand  
*Stochastic data assimilation methods (speaker)*
- Dec 2013: French Research Institute for Exploitation of the Sea (Ifremer), Brest, France  
*Workshop on 2D to 3D Ocean Dynamics from Space (invited speaker)*
- Apr 2013: NYU Abu Dhabi Research Institute, Abu Dhabi, United Arab Emirates  
*Workshop on Modelling, Observing and Assimilating Submesoscale Dynamics (invited speaker)*
- Dec 2012: American Geophysical Union Fall Meeting, San Francisco, CA  
*Session on Non-Gaussian/Nonlinear Aspects of Data Assimilation in Geosciences (invited speaker)*  
*Session on Physics and Biogeochemistry of Submesoscale Processes (poster)*

- Jul 2012: AIMS Conference on Dynamical Systems and Applications, Orlando, FL  
*Special session on Stochastic Statistical Modeling of Climate (invited speaker)*
- Feb 2012: American Geophysical Union Ocean Sciences Meeting, Salt Lake City, UT  
*Session on Dynamics and Observations of Submesoscale Oceanic Processes (speaker)*
- Dec 2011: American Geophysical Union Fall Meeting, San Francisco, CA  
*Session on Lagrangian Coherent Structures in Geophysical Flows (invited speaker)*  
*Session on Non-Gaussian/Nonlinear Aspects of Data Assimilation in Geosciences (speaker)*
- Sep 2011: Fudan University, Shanghai, China  
*Workshop on Statistical Inverse Modeling of Complex Nonlinear Systems (invited speaker)*
- Mar 2011: SIAM Conference on Issues in the Geosciences, Long Beach, CA  
*Minisymposium on Modeling, Analysis and Simulation of Oceanic Flows (invited speaker)*

## Departmental Seminars (selected)

- Dec 2016: California Institute of Technology, Pasadena, CA
- Aug 2016: School of Mathematics and Statistics, University of Sydney, Sydney
- Feb 2016: Department of Applied Mathematics, University of Colorado, Boulder
- Feb 2015: Institute for Marine and Antarctic Studies, University of Tasmania, Hobart
- Nov 2014: School of Marine and Atmospheric Sciences, Stony Brook University, New York
- Oct 2014: Applied Physics and Applied Mathematics, Columbia University, New York
- Oct 2014: NASA Jet Propulsion Laboratory, Pasadena, CA
- Oct 2014: Scripps Institution of Oceanography, San Diego, CA
- Jun 2013: School of Mathematics and Statistics, University of New South Wales, Sydney
- Apr 2013: Research School of Earth Sciences, Australian National University, Canberra
- Mar 2013: School of Mathematics and Statistics, University of Sydney, Sydney
- Dec 2012: Scripps Institution of Oceanography, San Diego
- Nov 2012: Department of Mathematical Sciences, Montclair State University
- Oct 2012: Laboratoire de Physique des Océans, Ifremer, Brest, France
- Sep 2012: Department of Mathematics, University of Wisconsin–Madison
- Feb 2012: Department of Geophysical Sciences, University of Chicago
- Mar 2011: Center for Atmosphere-Ocean Science, Courant Institute of Mathematical Sciences
- Feb 2011: Rosenstiel School of Marine and Atmospheric Science, University of Miami

## Educational Training and Experience

- **Foundations of University Learning and Teaching (Professional Development)**

This one-semester professional development program is aimed at developing the foundational knowledge, skills and dispositions necessary to teach in higher education, including modules in Educational Design, Teaching for Learning, Evaluation, and Assessment and Feedback. (Mar-June 2015)

- **Fundamentals of Mathematics: Calculus Strand (1st year undergraduate)**

Functions (and their inverses), limits, asymptotes, continuity; differentiation and applications; integration, the definite integral and applications; the logarithmic and exponential functions and applications; sequences.

- **Engineering Mathematics 2D (2nd year undergraduate)**

I have developed and rolled out an online / blended learning course for 2nd year Engineering undergraduates. This course integrates numerous web-based learning technologies including Maple TA, Moodle, YouTube for Education, and instant feedback polls.

- **Engineering Mathematics 2E (2nd year undergraduate)**

Partial differentiation and applications, vector algebra, double integrals, ordinary differential equations, introduction to vector field theory, extrema of functions of 2 variables, matrices and their applications, Laplace transforms, Fourier series, PDEs and applications.

- **Environmental Fluid Dynamics and Thermodynamics (Honours / Postgraduate)**

Fluid dynamics in a rotating reference frame; hydrostatic and geostrophic balance; quasi-geostrophic dynamics; gravity waves and Rossby waves; barotropic and baroclinic instabilities; turbulence and mixing.

- **Fluids, Oceans and Climate (3rd year undergraduate / Honours)**

Geostrophy; the conservation of potential vorticity; waves, tides, and buoyancy controlled flow. Atmosphere-ocean system as a global heat engine for driving climate variability and change. Incorporating computational experiments using the Dedalus fluid code and Python. To be delivered from August 2018.

- **Invited Lecturer, BoM Data Assimilation Summer School (Postgraduate)**

Invited to lecture graduate students on stochastic methods for data assimilation at the Bureau of Meteorology summer school on Data Assimilation. (Jan 2017)

- **Invited Lecturer, ARCCSS Winter School in Geophysical Fluid Dynamics (Postgraduate)**

Invited to lecture graduate students on topics in geophysical fluid dynamics at the ARC Centre for Excellence in Climate Systems Science winter school at the Australian National University. (Jun 2014)

## Supervision

- Postdoctoral co-supervisor: Matthew Archer, UNSW School of Mathematics and Statistics.
- PhD joint supervisor: Daniel Mackinlay, UNSW School of Mathematics and Statistics
- PhD co-supervisor: Yuehua Li, UNSW School of Mathematics and Statistics

- PhD co-supervisor: Alice Barthel, UNSW Centre of Excellence in Climate Science
- Honours supervisor: Max Davey (2017), Brendon Lai (2017)
- Undergraduate supervisor: Peter Nguyen, Tomas Beuzen, UNSW Vacation Scholarship

## Service and Outreach

**Professional Affiliations:** Associate Investigator, ARC Centre of Excellence in Climate System Science; Associate Investigator, Sydney Institute of Marine Science; Member, American Geophysical Union; Member, Australian Meteorological & Oceanographic Society.

- **Applied Mathematics Honours Coordinator**—Mar 2014–Present  
I coordinate students in the Applied Mathematics Honours program, help them find research projects, meet with them for seminar practice, and handle administrative duties.
- **Organizer, *Fluid Dynamics Seminar***—Jul 2014–Present  
Interdisciplinary seminar on all aspects of fluid dynamics, atmosphere-ocean science, and applied mathematics.
- **Publicity Committee, School of Mathematics and Statistics**—Mar 2013–Feb 2014  
I represented the Department of Applied Mathematics on the Publicity Committee, which oversees all the marketing, outreach and student recruitment activities in the School.
- **Session co-chair, AGU Ocean Sciences Meeting, New Orleans**—Feb 2015  
Co-chair of session on *Mesoscale and submesoscale processes: Characterization, dynamics, and representation*.
- **Conference Organizer, *Atmosphere-Ocean Science Days***—Jun 2011  
Three-day conference for graduate and postdoctoral researchers in AOS, held at Massachusetts Institute of Technology and Woods Hole Oceanographic Institution.
- **Coordinator, *Courant Splash***—Mar 2011  
Mathematics workshop for NYC high-school students held annually at the Courant Institute.
- **Organizer, *Student Seminar and Journal Club***—Fall 2009–Spring 2012  
Weekly seminars and journal club at the Courant Institute of Mathematical Sciences.
- **Voluntary Teacher, Loreto Day School, Calcutta, India**—Summer 2003  
Taught Math, Science, and English to street-children aged 7-15 years.

**Referee experience:** Chaos, Discrete and Continuous Dynamical Systems, Dynamics of Atmospheres and Oceans, Geophysical and Astrophysical Fluid Dynamics, Geophysical Research Letters, Journal of Atmospheric and Oceanic Technology, Journal of Computational Physics, Journal of Fluid Mechanics, Journal of Geophysical Research–Oceans, Journal of Physical Oceanography, National Science Foundation, Ocean Modelling, Quarterly Journal of the Royal Meteorological Society, Scientific Reports (Nature).

## References

- **K. Shafer Smith (Postdoctoral advisor)**—*Geophysical turbulence theory*  
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New York University, 251 Mercer Street, New York, NY 10012, USA  
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- **Patrick H. Diamond (Ph.D. Advisor)**—*Plasma turbulence theory, Solar physics*  
Distinguished Professor, Center for Astrophysics and Space Sciences,  
University of California San Diego, 9500 Gilman Drive, La Jolla, CA 92093, USA  
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- **M. Grae Worster**—*Fluid mechanics, Geophysics*  
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Tel: 44-1223 330850, Fax: 44-1223 765900, Email: grae@damtp.cam.ac.uk
- **Andrew J. Majda**—*Applied mathematics, Atmosphere–ocean science*  
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- **Peter R. Kramer**—*Applied mathematics, Fluid dynamics and stochastic processes*  
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- **Darryn W. Waugh**—*Atmospheric and oceanic transport and dynamics*  
Professor, Department of Earth & Planetary Sciences,  
Johns Hopkins University, 3400 N. Charles St, Baltimore, MD 21218, USA  
Tel: 1-410-516-8344, Fax: 1-410-516-7933, Email: waugh@jhu.edu
- **Edward A Spiegel**—*Astrophysical fluid dynamics, Convection, Pattern formation*  
Rutherford Professor of Astronomy, Department of Astronomy,  
Columbia University, 550 West 120th Street, New York, NY 10027, USA  
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