

Pedram Hassanzadeh

Rice University
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Appointments

Rice University

Assistant Professor (July 2016-present)
Department of Mechanical Engineering
Department of Earth, Environmental & Planetary Sciences (joint appointment)
PI: The Environmental Fluid Dynamics Group
Faculty Associate: Baker College

Harvard University

Associate, Department of Earth and Planetary Sciences (2016)
Postdoctoral Fellow, Department of Earth and Planetary Sciences (2015–2016), *Mentor: Zhiming Kuang*
Ziff Environmental Fellow, Center for the Environment (2013–2015), *Hosts: Zhiming Kuang & Brian Farrell*

University of California, Berkeley

Graduate Student Researcher, Department of Mechanical Engineering (2008–2013), *Advisor: Phil Marcus*

Woods Hole Oceanographic Institution

Geophysical Fluid Dynamics Program
PhD Student Fellow (summer 2012), *Supervisors: Charlie Doering & Greg Chini*
Staff Member (summers of 2014, 2017, 2018)

University of Waterloo

Research Associate, Department of Mechanical Engineering (2007–2008), *Supervisor: George Raithby*
Graduate Research Assistant, Department of Mechanical Engineering (2005–2007), *Advisor: George Raithby*

Education

University of California, Berkeley

PhD, Mechanical Engineering (2013)
Advisor: Phil Marcus
Thesis: *Baroclinic vortices in rotating stratified shearing flows: cyclones, anticyclones, and zombie vortices*

MA, Mathematics

 (2012)

Advisor: Jon Wilkening
Thesis: *Optimal transport from wall to wall*

University of Waterloo

MASc, Mechanical Engineering (2007)
Advisor: George Raithby
Thesis: *An efficient computational method for thermal radiation in participating media*

University of Tehran

BSc, Mechanical Engineering (2005)
Advisor: Vahid Esfahanian
Thesis: *Numerical simulation of electrokinetic flows in microchannels*

Honors & Awards

Early-Career Research Fellow, The National Academy of Sciences Gulf Research Program (2018)
 First-authored paper in GRL was selected for AGU Research Spotlight & Editor's Highlights (2014)
 Ziff Environmental Fellowship, Harvard University Center for the Environment (2013–2015)
 Postdoctoral Award for Professional Development, Office of Postdoctoral Affairs, Harvard University (2014)
 Geophysical Fluid Dynamics Fellowship, Woods Hole Oceanographic Institution (2012)
 NSERC Postgraduate Scholarship, Natural Sciences & Engineering Research Council of Canada (2009–2011)
 Outstanding Preliminary Examination Award, ME Department, UC Berkeley (2009)
 Jonathan Laitone Memorial Scholarship, ME Department, UC Berkeley (2009)
 Eiffel Scholarship, French Ministry of Foreign Affairs and International Development (2005, declined)
 International Graduate Student Award, University of Waterloo (2005–2007)

Funded Grant Proposals

As Sole/Lead PI:

NASA Modeling, Analysis and Prediction Program: Understand predictability and improve prediction of atmospheric blocking and associated extreme weather, 80NSSC17K0266, PI Hassanzadeh, \$295,665 (2017–2021)

Early-Career Research Fellowship Award from the The National Academy of Sciences Gulf Research Program: Weather extremes, climate change, and the Gulf, Awardee: Hassanzadeh, \$75,000 (2018–2020)

Rice Houston Engagement and Recovery Effort Fund: Effect of climate change on future Harvey-like hurricanes and the implications for Houston, PI Hassanzadeh, Co-PIs Bedient, Cohan & Yeung, \$50,000 (2017–2018)

Rice Faculty Initiative Fund: Data-driven reduced-order modeling of turbulent flows with applications in energy systems and the environment, PI Hassanzadeh, \$40,000 (2017–2018)

Microsoft AI for Earth: Predicting large-scale extreme-causing weather patterns using deep learning, PI Hassanzadeh, \$15,000 Microsoft Azure cloud-computing resources (2018–2019)

As Co-PI/Co-I or Subcontractee:

NSF Climate and Large-Scale Dynamics Program: Atmospheric blocking: dynamics and responses to climate change, AGS-1552385, PI Zhiming Kuang, \$540,436 (2016–2019). Subcontract to Rice: PI Hassanzadeh, \$147,000 (2016–2019)

NASA Nexus of Exoplanet Systems Science (NExSS): Origin and cycles of life-essential ingredients in young rocky planets, 80NSSC18K0828, PI Dasgupta, Co-PIs Hassanzadeh (15%), Isella, Lee, Lenardic & Yeung, \$6,654,014 (2018–2023)

Peer-Reviewed Publications

* indicates postdocs/students in my group

21. P. Hassanzadeh & Z. Kuang, Quantifying the annular mode dynamics in an idealized atmosphere, *J. Atmospheric Sciences* (under review)
20. Chattopadhyay* A. & P. Hassanzadeh, Identifying clustered weather patterns using a deep convolution neural network: A test case, *Proceedings of the 8th International Workshop on Climate Informatics* (accepted)

19. Khodkar* M. A., P. Hassanzadeh, N. Nabi & P. Grover, Reduced-order modeling of fully turbulent buoyancy-driven flows using the Green's function method, *Physical Review Fluids* (in revision)
18. Khodkar* M. A. & P. Hassanzadeh, Data-driven reduced modelling of turbulent Rayleigh-Bénard convection using DMD-enhanced Fluctuation-Dissipation Theorem, *J. Fluid Mechanics*, (852) 2018
17. Ronalds B., E. A. Barnes & P. Hassanzadeh, A barotropic mechanism for the response of jet stream variability to Arctic Amplification and sea ice loss, *J. Climate* (17) 2018
16. Anderson B. T., P. Hassanzadeh & R. Caballero, Persistent anomalies of the extratropical Northern Hemisphere wintertime circulation as an initiator of El Niño/Southern Oscillation events, *Scientific Reports*, (9) 2017
15. Jeevanjee N., P. Hassanzadeh, S. Hill & A. Sheshdari, A perspective on climate model hierarchies, *J. Advances in Modeling Earth Systems*, (7) 2017
14. Mahdinia M., P. Hassanzadeh, P. S. Marcus & C.-H. Jiang, Stability of 3D Gaussian vortices in rotating stratified Boussinesq flows: Linear analysis, *J. Fluid Mechanics*, (824) 2017
13. Ma D., P. Hassanzadeh & Z. Kuang, Quantifying the eddy-jet feedback strength of the annular mode in an idealized GCM and reanalysis data, *J. Atmospheric Sciences*, (74) 2017
12. Hassanzadeh P. & Z. Kuang, The linear response function of an idealized atmosphere. Part II: Implications for the practical use of the Fluctuation-Dissipation Theorem and the role of operator's nonnormality, *J. Atmospheric Sciences*, (79) 2016
11. Hassanzadeh P. & Z. Kuang, The linear response function of an idealized atmosphere. Part I: Construction using Green's functions and applications, *J. Atmospheric Sciences*, (79) 2016
10. Hassanzadeh P. & Z. Kuang, Blocking variability: Arctic Amplification versus Arctic Oscillation, *Geophysical Research Letters*, (42) 2015
9. Marcus P. S., S. Pei, C.-H. Jiang, J. Barranco, P. Hassanzadeh & D. Lecoanet, Zombie vortex instability. I. A purely hydrodynamic instability to resurrect the dead zones of protoplanetary disks, *Astrophysical J.*, (808) 2015
8. Hassanzadeh P., Z. Kuang & B. F. Farrell, Responses of midlatitude blocks and wave amplitude to changes in the meridional temperature gradient in an idealized dry GCM, *Geophysical Research Letters*, (41) 2014 (selected for AGU Research Spotlight & GRL Editor's Highlights)
7. Hassanzadeh P., G. P. Chini & C. R. Doering, Wall to wall optimal transport, *J. Fluid Mechanics*, (751) 2014
6. Marcus P. S., S. Pei, C.-H. Jiang & P. Hassanzadeh, Three-dimensional vortices generated by self-replication in stably stratified rotating shear flows, *Physical Review Letters*, (111) 2013
5. Hassanzadeh P., P. S. Marcus & P. Le Gal, The universal aspect ratio of vortices in rotating stratified flows: theory and simulation, *J. Fluid Mechanics*, (706) 2012
4. Hassanzadeh P. & G. D. Raithby, Efficient iterative solution of the P₁ equation, *J. Heat Transfer*, (131) 2008
3. Hassanzadeh P., G. D. Raithby & E. H. Chui, Efficient calculation of radiation heat transfer in anisotropically scattering media using the QL method, *J. Computational Thermal Sciences*, (1) 2009
2. Hassanzadeh P. & G.D. Raithby, Application of the finite volume method to the second-order radiative transfer equation: accuracy and solution cost, *J. Numerical Heat Transfer-B*, (53) 2008
1. Hassanzadeh P., G. D. Raithby & E. H. Chui, The efficient calculation of radiation heat transfer in participating media, *J. Thermophysics and Heat Transfer*, (22) 2008

Invited Talks

Predicting short-term evolution and long-term response of geophysical turbulence, *IUTAM Workshop on Stochastic Approaches to Transitions in Fluid Flows*, Cornell University, Ithaca 2018

Eddy feedback in the annular mode dynamics, *Columbia University*, SEAS Colloquium in Climate Science 2018

Predictability of extreme-causing weather patterns in the midlatitude turbulence, *SIAM Conference on Uncertainty Quantification*, Mini-symposium on Quantification and Prediction of Extreme Events in Complex Systems, Garden Grove 2018

Data-driven reduced modeling of geophysical turbulence, *Rice University*, Department of Computational & Applied Mathematics 2018

Harvey, jet stream, and climate change, *Urban Flooding & Infrastructure: Moving Forward from Harvey Conference*, Rice University SSPEED Center 2018

Jet stream variabilities and extreme weather events: A linear response function perspective, *SIAM Conference on Mathematics of Planet Earth*, Mini-symposium on Recent Theoretical and Computational Advances in Prediction of Rare and Extreme Events, Philadelphia 2016

Jet stream variabilities and extreme weather events, *Rice University*, Department of Earth Science 2016

Fluid dynamics of extreme weather events, *Rice University*, Department of Mechanical Engineering 2016

Blocking variability: Arctic Amplification versus Arctic Oscillation, *Columbia University*, SEAS Colloquium in Climate Science 2015

Midlatitude extreme weather events and climate change, *UCLA*, AOS Department seminar 2015

Extreme weather events in a changing climate, *Harvard University*, Center for the Environment 2015

Response of midlatitude extreme weather events to climate change, *UC Berkeley*, EPS colloquium 2015

Changes of midlatitude blocks and wave amplitude with reduced meridional temperature gradient: Arctic Amplification versus Arctic Oscillation, *MIT*, MASS seminar 2015

3D vortices in rotating stratified shearing flows: from oceans to Jupiter and beyond, *Caltech & UCLA* 2012

Other Presentations

Reduced-order modeling of Rayleigh-Benard turbulence, Geophysical Fluid Dynamics Summer School, Woods Hole Oceanographic Institution 2018

Reduced-order models for the large-scale atmospheric turbulence, APS March Meeting 2018

A linear response function to midlatitude jet variability, AMS Annual Meeting 2018

Reduced-Order Modeling of 3D Rayleigh-Benard Turbulent Convection, APS-DFD Meeting 2017

Annular Mode Dynamics: Eddy Feedbacks and the Underlying Mechanisms, AGU Fall Meeting 2017 (poster)

Accurate linear response functions of global climate models: Calculations and applications, Geophysical Fluid Dynamics Summer School, Woods Hole Oceanographic Institution 2017

Quantifying annular mode dynamics, AMS-AOFD Meeting 2017 (poster)

Reduced-order modeling of turbulent flows for flow control and more, Texas Systems Day, Texas A&M 2017

Data-driven reduced-order modeling of turbulent flows, OGHPC, Rice University 2017 (poster)

Accurate calculation of the linear response function of General Circulation Models, APS-DFD Meeting 2016

Accurate linear response function of general circulation models, Modeling Hierarchies Workshop, Princeton University 2016 (poster)

Blocking variability: relationship with Arctic Oscillation, Arctic Amplification, and synoptic eddies, Workshop on Atmospheric Blocking, University of Reading 2016

Responses of midlatitude blocking activity and wave amplitude to reduced meridional temperature gradient: Arctic Amplification versus Arctic Oscillation, AMS-AOFD Meeting 2015

The linear response function of an idealized atmosphere, AMS-AOFD Meeting 2015 (poster)

How do midlatitude blocks and wave amplitude respond to changes in the meridional temperature gradient? a study with an idealized dry GCM, AGU Fall Meeting 2014 (poster) & AMS Annual Meeting 2015

Atmospheric blocks and wavy jet streams: how well do we understand the fluid dynamics of midlatitude weather extremes? Workshop on Geophysical and Astrophysical Turbulence, IPAM-UCLA 2014 (poster)

On the unexpected longevity of the Great Red Spot, oceanic eddies, and other baroclinic vortices, APS-DFD Annual Meeting 2013

The unexpected longevity of baroclinic vortices, workshop on Connecting Theory to Experiments in Geophysical and Astrophysical Fluid Dynamics, UCLA 2013

A universal diagnostic equation for the aspect ratio of oceanic eddies and its applications: theory, simulation, experiment and observation, AGU Fall Meeting 2012

3D baroclinic vortices in rotating stratified shear: from an orange Great Red Spot to planet formation, AGU Fall Meeting (poster) & APS-DFD Annual Meeting 2012

Optimal transport: Wall to wall, UC Berkeley Fluids Seminar and WHOI GFD Program 2012

3D structure and internal circulation of pancake vortices in rotating stratified flows, NCAR IMAGE Theme of the Year on Turbulence workshop 2012 and APS-DFD Annual Meeting 2011

How do 3D vortices spin down, or do they?, APS-DFD Annual Meeting 2010

The efficient calculation of radiation heat transfer in anisotropically scattering media using the QL method, Advances in Computational Heat Transfer Conference, Marrakesh 2008 (poster)

Professional Services & Memberships

Organizer

Session *Extratropical Large-Scale Atmospheric Circulation Variability*, AGU Fall Meeting (2017, 2018)

Session *Relating the Internal Variability of Climate Systems and their Forced Responses*, AGU Fall Meeting (2018)

Focus Session *Fluid Dynamics of Atmosphere and Ocean Extremes*, APS-DFD Annual Meeting (2018)

Reading group *Extreme Weather Events in a Changing Climate*, Harvard University (2015–2016)

Chair

Session *Extratropical Large-Scale Atmospheric Circulation Variability*, AGU Fall Meeting (2017, 2018)

Session *Relating the Internal Variability of Climate Systems and their Forced Responses*, AGU Fall Meeting (2018)

Focus Session *Fluid Dynamics of Atmosphere and Ocean Extremes*, APS-DFD Annual Meeting (2018)

Session *Nonlinear Dynamics: Model Reduction*, APS-DFD Annual Meeting (2018)

Session *Midlatitude and tropospheric-stratospheric interaction*, Modeling Hierarchies Workshop, Princeton 2016

Session *Transport & Mixing*, AMS-AOFD Meeting, Minneapolis 2015

Session *Geophysical: Stratified Flows*, APS-DFD Annual Meeting, Pittsburgh 2013

Memberships

American Geophysical Union (AGU), American Physical Society (APS), Society of Industrial and Applied Mathematics (SIAM), American Meteorological Society (AMS)

Reviewer

National Science Foundation (ad hoc and panel), Geophysical Research Letters, Journal of Fluid Mechanics, Journal of Climate, Climate Dynamics, Journal of Geophysical & Astrophysical Fluid Dynamics, Proceedings of the Royal Society A, Atmospheric Chemistry & Physics, Journal of Applied Meteorology & Climatology, Probabilistic Engineering Mechanics

Advising at Rice University

Postdoctoral Research Associates

Dr. Amin Khodkar (2017-present)

Dr. Lei Wang (2017-present); joint with Prof. Zhiming Kuang at Harvard University

PhD Students

Ashesh Chattopadhyay (2017-present), recipient of BP HPC Graduate Fellowship from Ken Kennedy Institute

Ebrahim Nabizadeh (2017-present)

MS Students

David Lee (2018-present), supported by US Air Force

Researchers

Andy Corbato (MECH undergraduate student, Spring 2018-present)

Joey Lou (MECH undergraduate student, Summer 2018-present)

Vincent Gonzales (CAAM undergraduate student, Spring 2018-Summer 2018)

Arthi Appathurai (CHEB MS student, Spring 2017-Summer 2018)

Sebastian Jia (MECH undergraduate student, Summer 2017)

Teaching

Graduate-Level Courses

MECH 575: Introduction to Hydrodynamic Stability (Spring 2017, 2018)

MECH 612: Independent Study on Geophysical Fluid Dynamics (Spring & Fall 2018)

Undergraduate-Level Courses

MECH 371: Fluid Mechanics (Fall 2017, 2018)

Rice University Services

University Committees

Faculty search committee, Civil and Environmental Engineering Department (Spring 2018)

School of Engineering Strategic Planning committee (Fall 2017-Spring 2018)

Commencement marshal (Spring 2017 and 2018)

Department Committees

Co-chair: Seminar series committee (2018-present)

Graduate studies committee (2016-present)

PhD Thesis Committee

MECH: Fouad Shehab (Spring 2018)

Civil & Environmental Engineering: Katherine Anarde (Fall 2018)

Earth Science: Hehe Jiang (Spring 2018), Sriparna Saha (TBD)

MATH: Chao Li (Spring 2018)

PhD Qualifying Exam Committee

MECH: David Warden (Spring 2017)

Civil & Environmental Engineering: Katherine Anarde (Fall 2018)

MECH Preliminary Candidacy Evaluation Committee

Kenechi Agbim, Nick Jean-Louis & Tim Petrosius (PhD, Spring 2018), Deng Yang (MS, Spring 2018), Issam Ben Moallem & Marcelo Fernandes (PhD, Spring 2017), Hankun Deng (MS, Spring 2017)

Master's Thesis Committee

MECH: Enguang Zhou, Damon Kirkpatrick, Mohamed Nemer & Hankun Deng (Spring 2018), Emre Sarici, Xindi Li & Heqi Xu (Spring 2017)

MME Field Report

Daniel King, Jingw Wan, Da Wang, Guangyi Chen & Zhaoyuan Zhou (Spring 2017)

Other

Keynote: The Gulf Coast Undergraduate Research Symposium, Rice University 2016

Judge: Rice University Undergraduate Research Symposium, 2016, 2017, 2018