Disaster Prevention Research Institute
Kyoto University
Gokasho, Uji 611-0011, Kyoto, Japan
☎ *+1 612-547-6284*
✉ *marc.kjerland@gmail.com*
http://www.marckjerland.com
marckjerland

Marc Kjerland

Research interests

- Numerical methods for PDEs
- Geophysical modeling and climate change impacts
- Nonlinear dynamical systems
- Multiscale modeling
- Data analysis

Current position

2015 – present **Disaster Prevention Research Institute**, *Postdoctoral researcher*, Kyoto University.

- Numerical simulation of storm surge and the impacts of climate change on coastal hazards
- Supervised by Nobuhito Mori in the Coastal Hazards Laboratory

Education

2010 – 2015 **Doctor of Philosophy**, *Applied Mathematics*, University of Illinois at Chicago.

2007 – 2009 **Master of Science**, *Applied Mathematics*, University of Illinois at Chicago.

2002 – 2005 **Bachelor of Science**, *Mathematics with minor in Computer Science*, University of Minnesota, Twin Cities.

Publications

- Mori, N., Kjerland, M., Nakajo, S., Shibutani, Y., Shimura, T. (2016). *Impact assessment of climate change on coastal hazards in Japan.* Hydrological Research Letters, Vol. 10, No. 3, p. 101-105.
- Abramov, R. & Kjerland, M. (2016). *The response of reduced models of multiscale dynamics to small external perturbations.* Communications in Mathematical Sciences, Vol 14, No 3.
- Christodoulides, P., Dias, F., Ghidaglia, J.-M., & Kjerland, M. (2010). *On the Effect of Compressibility on the Impact of a Falling Jet.* Proceedings of the 20th International Offshore and Polar Engineering Conference, Vol. III, Beijing, China.

Doctoral thesis

Title *Linear response closure approximations for multiscale systems.*

Advisor Rafail Abramov

Description For large multiscale systems with processes evolving on fast and slow timescales, direct simulation of long-term behavior can be numerically intractable. We present a model reduction method for the slow dynamics of a two-timescale system of ODEs using an averaging method combined with a first-order response correction for the fast variables using invariant statistics of the fast and slow components. We apply this technique to the Lorenz 96 system, a toy model for atmospheric flow, and examine the dynamics and perturbation response of the reduced models in a variety of parameter regimes.

Previous research positions

2014 – 2015 **Institute for Environmental Science and Policy**, *Research assistant*, University of Illinois at Chicago (UIC).

- Data analysis project comparing universities from an urban metabolism perspective
- Implemented multivariate regression models, optimization methods, and regime shift detection
- Supervised by Ning Ai. Papers in progress.

2010 – 2014 **Dept of Mathematics**, *Research assistant*, UIC.

- Examined dynamics of closure approximations to two-timescale systems in chaotic and quasi-periodic parameter regimes
- Generated ensemble solutions to estimate perturbation response and invariant statistics of multiscale and reduced systems
- Supervised by Rafail Abramov

Sep 2009 – March 2010 **Centre de Mathématiques et de leurs applications**, *Stage de recherche*, École Normale Supérieure de Cachan, France.

- Improved boundary conditions for multiphase compressible fluid solver using a finite volume discretization with Lagrangian interface tracking
- Compared solutions of faucet flow for compressible and ideal fluids
- Supervised by Jean-Michel Ghidaglia and Frédéric Dias

Spring 2006 **Minnesota Supercomputing Institute**, *Research assistant*, University of Minnesota.

- Tested and documented the Co-Array Fortran extension with two other students. Supervised by Robert Numrich

Workshops

August 2016 **University of Washington**, *Clawpack Developers' Workshop and Hackathon*, Seattle, WA.

- Informal workshop for current and future developments of open source hyperbolic PDE solver Clawpack
- Emphasis on GeoClaw package for depth-averaged flows with adaptive mesh refinement
- Lightning talk: *Hazard assessment of storm surge*

June 2016 **University of Maryland**, *The Burgers Program Research School on Fluid Dynamics*, College Park, MD.

- Series of tutorial sessions on topics in nonlinear waves
- Poster: *Storm surge simulation using adaptive mesh refinement*

November 2013 **Institute for Mathematics and its Applications**, *Predictability in Earth System Processes*, Minneapolis, MN.

- Workshop on data assimilation, model parametrization, and model validation

- Invited talk: *Model reduction and fluctuation-dissipation for two-timescale systems*

October 2013 **Rennaissance Computing Institute**, *Mathematics and Climate Research Network (MCRN) Annual Meeting*, Chapel Hill, North Carolina.

- Focus group meetings and discussion of future initiatives for a National Science Foundation (NSF) funded network of mathematicians and geoscientists
- Poster: *Linear response closure approximation for two-timescale systems*

July – August 2013 **Centro de Investigación en Matemáticas, A.C.**, *Mathematics of Climate Change, Related Natural Hazards and Risks*, Guanajuato, Mexico.

- Satellite meeting of the 2013 Mathematical Congress of the Americas
- Poster: *Linear response closure approximation for systems with two timescales*

Spring 2010, Dec 2011, Dec 2012 **Institute for Pure and Applied Mathematics (IPAM)**, *Model and Data Hierarchies for Simulating and Understanding Climate*, University of California, Los Angeles.

- Series of workshops and residency for geophysicists and applied mathematicians (NSF travel grant)
- Invited talk: *Linear response closure approximation for two-timescale systems*
- Junior session talk: *Multi-material compressible flow in a finite volume framework*

July 2008 **Mathematical Sciences Research Institute (MSRI)**, *Climate change summer school*, University of California, Berkeley.

- Graduate student summer school on mathematical topics for climate change research
- Conducted independent research on parameter regimes of Lorenz '63 system

Conferences and other presentations

September 2016 **SIAM Conference on Mathematics of Planet Earth**, Philadelphia, PA.

- SIAM Poster Prize: *Simulating storm surge of [Tropical Cyclone] Haiyan in a future climate condition using adaptive mesh refinement*
- Minisymposium talk in session *Methodologies for Probabilistic Hazard Assessment*

September 2016 **CLIVAR Open Science Conference**, *Simulating storm surge of [Tropical Cyclone] Haiyan in a future climate condition using adaptive mesh refinement*, Poster session, Qingdao, China.

March 2016 **Inver Hills Community College**, *Mathematical modeling of the earth's climate*, Invited lecture, Inver Grove, MN.

February 2016 **MCRN**, *Storm surge modeling using adaptive mesh refinement with application to Typhoon Haiyan*, MCRN Colloquium Webinar.

AGU Ocean Sciences Meeting, *Storm surge modeling using adaptive mesh refinement with application to Typhoon Haiyan*, Oral Presentation, New Orleans, LA.

April 2014 **Minneapolis Community and Technical College**, *Celestial motion and the three-body problem*, Math club guest lecture.

November 2013 **MCRN**, *Model reduction and response for two-timescale systems with nonlinear coupling*, Data Assimilation for Model Parameterization webinar.

April 2013 **UIC**, *Mathematical Modeling of the Earth's Climate*, Undergraduate Math Club.

March 2013 **UIC**, *Chaos and perturbations in nonlinear systems*, Graduate student seminar.

January 2013 **Joint Mathematics Meetings**, *Linear response closure approximation for multiscale systems*, AMS Special Session on Challenges in Data Assimilation and the Mathematics of Planet Earth and its Climate, San Diego, CA.

Dynamics Days US, *Linear response closure approximation for multiscale systems*, Contributed talk, Denver, CO (Univ of Colorado travel award).

December 2012 **Science Day**, *Modeling Climate Change*, General audience talk, Minnehaha Free Space, Minneapolis, MN.

University of La Verne, *The Mathematics of Climate Change*, Invited lecture, La Verne, CA.

November 2012 **Drexel University**, *Linear response closure approximation for multiscale systems*, Graduate student seminar, Philadelphia, PA.

New Jersey Institute of Technology, *Linear response closure approximation for multiscale systems*, Fluids seminar, Newark, NJ.

July 2012 **Society for Industrial & Applied Mathematics (SIAM) Annual Meeting**, *Linear response closure approximation for multiscale systems*, Poster session, Minneapolis, MN (SIAM Student travel award).

June 2012 **International Union of Geodesy and Geophysics (IUGG) Conference on Mathematical Geophysics**, *Linear response closure approximation for multiscale systems*, Contributed talk, Edinburgh, Scotland (NSF travel award).

February 2011 **UIC**, *Finite volume method for hyperbolic PDEs*, Graduate applied math seminar.

October 2010 **UIC**, *Multi-material compressible flow in a finite volume framework*, SIAM student seminar.

Teaching

April 2009 **Graduate Student Teaching Award**, *Dept of Mathematics, UIC.*
Awarded for exceptional teaching and strong academic progress

2007 – 2009 **Teaching assistant**, *Dept of Mathematics, UIC.*
Led discussion sections, wrote quizzes, graded assignments, and tutored students in Calculus I, Finite Math for Business, Business Calculus

Service

2016 **GeoClaw software package**, *Contributing developer*, GitHub.

- Added module to include forcing from atmospheric model output for storm surge modeling
- github.com/MarcKjerland/geoclaw

2013 – 2014 **Ocean biogeochemistry focus group**, *Organizer*, MCRN.

- Organized speakers and discussions for webinar meetings with mathematicians and geoscientists
- Topics of discussion include current models of biogeochemical processes and techniques for coupled nonlinear systems

April 2013 **Chicago-Area SIAM Student Conference**, *Co-organizer*, UIC.

- Conference for graduate and undergraduate students in applied mathematics and related disciplines
- Jointly organized with students from UIC, Northwestern University, and Illinois Institute of Technology

2010 – 2013 **SIAM student chapter at UIC**, *Organizing committee.*

2009 – 2013 **UIC Graduate Employees Organization (Local 6297)**, *Steering committee.*

- Served on several committees of labor union representing over 1400 teaching assistants and graduate assistants at UIC

December 2012 **Science Day**, *Organizer*, Minnehaha Free Space, Minneapolis, MN.

- General audience event featuring science and mathematics presentations at a progressive community space

Spring 2011 **Graduate applied math seminar**, *Organizer*, UIC.

- Organized and presented seminars on numerical methods for PDEs

Languages

C	**fluent**	*preferred language for computation*
Matlab/Octave	**fluent**	*great for mathematical protoyping*
Python	**intermediate**	*preferred language for data analysis, visualization, and prototyping*
Fortran	**intermediate**	*contributed to numerical solvers for fluid flow*
LaTeX	**fluent**	*preferred language for professional documents and presentations*
Bash script	**fluent**	*command line and shell scripting on unix-like systems*
French	**fluent**	*spoken and written. 'mother' tongue plus coursework*
German	**intermediate**	*spoken and written. courses at Sprachschule Babylonia in Berlin*
Japanese	**beginner**	*currently immersed. lessons in Uji, Japan*

Other Interests

I greatly enjoy traveling, bicycling, cooking & baking, live music, photography, craft beer, and do-it-yourself culture.