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 partial differential equations
- Geophysical modeling and climate change impacts
- Computational fluid dynamics
- Nonlinear dynamical systems
- Multiscale modeling
- Data analysis

Current position

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

- Topic: Numerical simulation of storm surge and the impacts of climate change on coastal hazards
- I develop and validate storm surge simulations using atmospheric storm hindcast data and adaptive mesh refinement via the GeoClaw numerical solver. We are investigating impacts of changing typhoon distributions on coastal flooding in the northwest Pacific.
- Supervised by Nobuhito Mori in the Coastal Hazards Laboratory

Education

2010 – 2015 **Doctor of Philosophy**, *Applied Mathematics*, University of Illinois at Chicago.
Title: Linear response closure approximations for multiscale systems.
Advisor: Rafail Abramov

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

2002 – 2005 **Bachelor of Science**, *Mathematics*, University of Minnesota, Twin Cities.

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.

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 multi-scale 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.

Previous positions

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

- Data analysis project applying an urban metabolism perspective to university performance
- Implemented multivariate regression models, linear optimization methods for weighted comparisons, and regime shift detection
- Supervised by Ning Ai

2010 – 2014 **Department of Mathematics**, *University of Illinois at Chicago.*
Research assistant

- 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**, *École Normale Supérieure de Cachan*, France.
Research assistant *(Stage de recherche)*

- 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

2007 – 2009 **Department of Mathematics**, *University of Illinois at Chicago.*
Teaching assistant

- Led discussion sections, wrote quizzes, graded assignments, and tutored students in Calculus I, Finite Math for Business, and Business Calculus

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

- Tested and documented the Co-Array Fortran extension. Supervised by Robert Numrich

Awards

September 2016 **SIAM poster prize**, *SIAM Conference on Mathematics of Planet Earth.*
Title: *Simulating storm surge of [Tropical Cyclone] Haiyan in a future climate condition using adaptive mesh refinement*

March – June 2010 **NSF visiting fellowship**, *Institute for Pure and Applied Mathematics*, University of California, Los Angeles.
Long program: Model and Data Hierarchies for Simulating and Understanding Climate

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

Technical skills

Programming languages: C/C++, Python, Matlab, Fortran

Natural languages: English, French, German, Japanese

Operating systems: GNU/Linux, Mac OS X

Geographic software: QGIS, GDAL

Other computing: LaTeX, Bash scripting, OpenMP, GitHub

Office & graphics: Word, Excel, Photoshop/GIMP

Workshops

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

- Workshop for developments of open source hyperbolic PDE solver. Emphasis on GeoClaw package for depth-averaged flows with adaptive mesh refinement
- Lightning talk: *Hazard assessment of storm surge*

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

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

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

- Workshop on data assimilation, model parametrization, and model validation
- Invited talk: *Model reduction and fluctuation-dissipation for two-timescale systems*

October 2013 **Mathematics and Climate Research Network (MCRN) Annual Meeting**, *Rennaissance Computing Institute*, 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 **Mathematics of Climate Change, Related Natural Hazards and Risks**, *Centro de Investigación en Matemáticas, A.C.*, 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 **Model and Data Hierarchies for Simulating and Understanding Climate**, *Institute for Pure and Applied Mathematics*, University of California, Los Angeles.

- Series of workshops and residency for geophysicists and applied mathematicians (NSF travel & housing 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 **Climate change summer school**, *Mathematical Sciences Research Institute*, 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

Other presentations

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

- Poster: *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*

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.

Service

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

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

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

- Organized speakers and discussions for webinars with mathematicians and geoscientists. Topics included biogeochemical process models 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. Hosted at UIC.

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

Other Interests

I greatly enjoy traveling, bicycling, cooking & baking, live music, board games, and do-it-yourself culture.