

Marc Kjerland

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Research interests

- Numerical methods for PDEs, especially finite volume methods
- Geophysical modeling and climate change impacts
- Computational fluid dynamics
- 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 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.

Technical skills

Programming languages: C/C++, Python, Matlab, Fortran
Natural languages: English, French, German, Japanese
Operating systems: GNU/Linux, Mac OS X
Geographic: QGIS, GDAL

Other computing: L^AT_EX, Bash scripting, OpenMP, GitHub
Office & graphics: Word, Excel, Photoshop/GIMP

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

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. 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 **Renaissance 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

Other Interests

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