Disaster Prevention Research Institute
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Marc Kjerland

Research interests

- Geophysical modeling and climate change impacts
- Nonlinear and multiscale systems
- Numerical methods
- Data analysis

Current position

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

- Develop and validate storm surge simulations using adaptive mesh refinement
- Quantify impacts of changing typhoon distributions on coastal hazards
- Contributed module to GeoClaw (GitHub) incorporating atmospheric model output.

Education

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

2007 – 2009 **M.S.**, *Applied Mathematics*, University of Illinois at Chicago.

2002 – 2005 **B.S.**, *Mathematics*, University of Minnesota, Twin Cities.

Technical skills

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

Python packages: numpy, scipy, sklearn, pandas, matplotlib, jupyter, gdal

Operating systems: GNU/Linux, Mac OS X, Windows

Other: LaTeX, Bash scripting, OpenMP, GitHub, QGIS, Excel, Photoshop

Natural languages: English, French, German, Japanese

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.

Previous positions

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

- Applied urban metabolism perspective to evaluate university performance
- Implemented multivariate regression models, linear optimization methods for weighted comparisons, and regime shift detection

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

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

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.

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

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.

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 support)
- 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.