

## Dr. Joseph H. Kennedy

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### CONTACT INFORMATION

Oak Ridge National Laboratory  
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### RESEARCH INTERESTS

- ◇ Verification, validation and uncertainty quantification of Earth system models and their constituents
- ◇ Developing cross-disciplinary tools to facilitate collaboration, sharing, and reproducibility
- ◇ Applying computational physics methods to novel and unique problems
- ◇ Investigating the link between climate history and ice crystalline fabric
- ◇ Glacier dynamics and the effects of anisotropic ice on bulk properties

### PROFESSIONAL EXPERIENCE

**Oak Ridge National Laboratory**, Oak Ridge, Tennessee, USA

*Computational Scientist in Glaciology*

Climate Change Science Institute

**December 2016 – present**

Perform research tasks using Earth System Models (ESMs; e.g., DOE's E3SM, CESM) and ice sheet models (e.g., MPAS-LI, BISICLES, PISM, CISM); coordinate the verification and validation of E3SM, MPAS-LI, and BISICLES simulations; development of the Land Ice Verification and Validation toolkit (LIVVkit), a python-based toolkit for robust evaluation of ice-sheet models; and develop an extended V&V evaluation tool (EVE) for climate reproducibility testing of ESMs.

**Oak Ridge National Laboratory**, Oak Ridge, Tennessee, USA

*Postdoctoral Research Associate*

Climate Change Science Institute

**January 2015 – November 2016**

Perform research tasks using the Community Ice Sheet Model (CISM) and coordinate the development of the Land Ice Verification and Validation toolkit (LIVVkit) — a python-based toolkit for robust evaluation of ice-sheet models.

Advisor: Dr. Katherine J. Evans

### EDUCATION

**University of Alaska Fairbanks**, Fairbanks, Alaska, USA

*Department of Physics*

**Ph.D., 2015**, Dissertation Topic:

“Linking climate history and ice crystalline fabric evolution in polar ice sheets.”

Advisor: Dr. Erin C. Pettit

**Western Washington University**, Bellingham, Washington, USA

*Department of Physics*

**B.S., Physics**, June, 2008

Minors: Astronomy, The Study of Religion

### SELECTED PUBLICATIONS

Lipscomb, W.H., S.F. Price, M.J. Hoffman, G.R. Leguy, A.R. Bennett, S.L. Bradley, K.J. Evans, J.G. Fyke, *J.H. Kennedy*, M. Perego, D.M. Ranken, W.J. Sacks, A.G. Salinger, L.J. Vargo, and Patrick H. Worley. (In Review). Description and evaluation of the community ice sheet model (CISM) v2.1. Geoscientific Model Development.

[Discussion article: gmd-2018-151. \(Online soon\)](#)

Evans, K.J., *J.H. Kennedy*, D. Lu, M.M. Forrester, S. Price, J. Fyke, A.R. Bennett, M. Hoffman, I. Tezaur, C. Zender, and M. Vizcaino. (In Review). LIVVkit 2.1: Automated and extensible ice sheet model validation. Geoscientific Model Development.

[Discussion article: gmd-2018-70.](#)

Goelzer, Heiko, S. Nowicki, T. Edwards, M. Beckley, A. Abe-Ouchi, A. Aschwanden, R. Calov, O. Gagliardini, F. Gillet-Chaulet, N. Golledge, J. Gregory, R. Greve, A. Humbert, P. Huybrechts, *J.H. Kennedy*, E. Larour, W. Lipscomb, S. Le clec'h, V. Lee, M. Morlighem, F. Pattyn, T. Payne, C. Rodehacke, M. Ruckamp, F. Saito, N. Schlegel, H. Seroussi, A. Shepherd, S. Sun, R. van de Wal, F. Ziemen. (2018). Design and results of the ice sheet model initialization experiments initMIP-Greenland: An ISMIP6 intercomparison. *The Cryosphere*, 12, 1433–1460.  
doi:10.5194/tc-12-1433-2018

*Kennedy, J.H.*, A.R. Bennett, Evans, K.J., S. Price, M. Hoffman, W.H. Lipscomb, J. Fyke, L. Vargo, A. Boghazian, M. Norman, P.H. Worley. (2017). LIVVkit: An extensible, python-based, land ice verification and validation toolkit for ice sheet models. *Journal of Advances in Modeling Earth Systems*, 9(2), 854–869.  
doi:10.1002/2017MS000916

Price, S., M. Hoffman, J. Bonin, T. Neumann, I. Howat, J. Saba, J. Guerber, D. Chambers, K.J. Evans, *J.H. Kennedy*, J. Lenaerts, W.H. Lipscomb, M. Perego, A. Salinger, R. Tuminaro, M. van den Broeke, and S.M.J. Nowicki. (2017). An ice sheet model validation framework for the Greenland ice sheet. *Geoscientific Model Development*, 10, 255–270.  
doi:10.5194/gmd-10-255-2017

*Kennedy, J.H.*, and E.C. Pettit (2015). The response of climate induced fabric variations to simple shear and migration recrystallization. *Journal of Glaciology*, 61(227), 537–550.  
doi:10.3189/2015JoG14J156.

*Kennedy, J.H.*, E.C. Pettit, and C.L. Di Prinzio (2013). The evolution of crystal fabric in ice sheets and its link to climate history. *Journal of Glaciology*, 59(214), 357–373.  
doi:10.3189/2013JoG12J159.

Gusmeroli, A., E.C. Pettit, *J.H. Kennedy*, and C. Ritz (2012). The crystal fabric of ice from full-waveform borehole sonic logging. *J. Geophys. Res.*, 117, F03021.  
doi:10.1029/2012JF002343.

## GRANT PROPOSALS

DOE BER/ASCR sea-level projections (2017)  
**Co-I and V&V task lead, funded:** *Probabilistic sea-level projections from ice sheet and Earth system models*, \$1.33M over 5 years to ORNL

DOE BER ACME-SM project (2016)  
**Co-I, funded:** *A Global climate model software modernization surge*, \$1.35M over 3 years to ORNL

ORNL/NOAA performance project (2016)  
**CO-I, funded:** *Performance analysis of climate workflows*, \$336K over 1 year to ORNL

DOE BER RGCM-IAR Integration Framework for Climate Evaluation (2016)  
Co-I, declined, *Biofuels, land-use change, and implications for the water-energy-food nexus: a multi-model systems approach*, \$1.8M over 3 years to ORNL

## SIGNIFICANT REPORTS AND WHITE PAPERS

*Kennedy, J.H.*, B.W. Mayer, K.J. Evans, J. Durachta (2017). Performance analysis of large scale HPC workflows for Earth system models. ORNL Technical Memo, ORNL/TM-2017/540.  
doi:10.2172/1439154

Allen, M.R., H.M.A. Aziz, M.A. Coletti, *J.H. Kennedy*, S.S. Nair, and O.A. Omitaomu (2017). Workshop on human activity at scale in Earth system models. ORNL Technical Memo, ORNL/TM-2017/24. doi:10.2172/1343540

*Kennedy, J.H.*, B. Debusschere, K. Sargsyan, F.M. Hoffman, K.J. Evans (2016). Full-system evaluation of Earth system models. Ideas paper 51 in E. Ng, K.J. Evans, et al. (Authors), *Advancing Cross-Cutting Ideas for Computational Climate Science*, Workshop Report, Rockville, MD, September 12-13, 2016. ORNL/TM-2016/717. doi:10.2172/1341564.

Law, K., R. Archibald, *J.H. Kennedy* (2016). Data assimilation for ice-sheet models. Ideas paper 22 in E. Ng, K.J. Evans, et al. (Authors), Advancing Cross-Cutting Ideas for Computational Climate Science, Workshop Report, Rockville, MD, September 12-13, 2016. ORNL/TM-2016/717. doi:10.2172/1341564.

## SOFTWARE

E3SM ([Energy Exascale Earth System Model](#)) core developer (infrastructure group) for phase 2; DOE's E3SM is a state-of-the-science Earth system model development and simulation project to investigate energy-relevant science using code optimized for DOE's advanced computers. Latest open-source release of E3SM, version 1.0.0, was on April 23, 2018. <https://github.com/E3SM-Project/E3SM>

Lead developer of the Land Ice Verification and Validation toolkit (LIVVkit); a python-based, extensible verification and validation suite for land-ice models. Latest open-source release of LIVVkit, version 2.1.3, was on July 28, 2018. <https://github.com/LIVVkit/LIVVkit>

Developer of the ISMIP6 Atlas submission validation tool; an extension to LIVVkit which checks submissions to ISMIP6 experiments for correct file names, paths, metadata, etc. and produces a large variety of diagnostic plots. <https://github.com/LIVVkit/Atlas>

Developer on DOE's E3SM ecosystem projects

- ◊ MPAS-Analysis: Analysis for simulations produced with Model for Prediction Across Scales (MPAS) components and DOE's E3SM. <https://github.com/MPAS-Dev/MPAS-Analysis>
- ◊ A-Prime: Python based scripts to generate coupled priority metrics for DOE's E3SM. <https://github.com/ACME-Climate/a-prime>
- ◊ EVE: Extended verification and validation for Earth system models, public release forthcoming.

Contributor to open-source software projects

- ◊ Conda-forge recipe maintainer for [JSON tricks](#)
- ◊ PR19 and PR27 to [sphinx-js](#) leading to release of (bugfix) v2.0.1 and contributing to v2.2.

*Past:* Developer and integrator for the joint DOE/NSF Community Ice Sheet Model (CISM); a next-generation ice sheet model used for predicting ice sheet evolution and sea level rise in a changing climate. Last public, open-source release of CISM was version 2.0.5 on was August 28, 2015.

## ALLOCATION PROPOSALS

Energy Research Computing Allocations Process (ERCAP) for NERSC (2016)

**Co-I, accepted**, *Predicting ice sheet and climate evolution at extreme scales*, 10M hours on Edison

OLCF Directors Discretion Allocation (2015)

**Co-I, accepted**, *Earth system modeling collaborative*, 10M hours on Titan

## AWARDS

**2016 CCSI Professional Development Award**, \$100,000

Co-I: *Understanding the links between neighbourhood level human activity and global climate change by developing an integrative methodology using data analytics, agent-based modelling and Earth system modelling*. Project PI: Dr. Melissa R. Allen.

Climate Change Science Institute, Oak Ridge National Laboratory

**2013–2014 Thesis Completion Fellowship**, \$15,000 + tuition

University of Alaska Fairbanks Graduate School

**2011–2012 CASE GK-12 Fellow**, \$45,000

NSF Graduate STEM Fellow in K-12 Education, Changing Alaska Science Education

SYNERGISTIC ACTIVITIES	2016–present	Referee for the Australian Antarctic Division, the Geophysical Journal International, and the Journal of Mountain Science
	2015–present	Currently participating in the Ice Sheet Model Intercomparison Project 6 (ISMIP6)
	2015–present	Conducting multiple experiments for the Initialization of Models Intercomparison Project (initMIP)
	2015–present	Outreach talks, entitled <ul style="list-style-type: none"> <li>◊ <i>The coolest science: Glaciers in the Earth system</i> <ul style="list-style-type: none"> <li>◊ ORISE Summer Seminar Series, invited, July 18, 2018</li> </ul> </li> <li>◊ <i>Using computational science to understand Earth's climate</i> <ul style="list-style-type: none"> <li>◊ UT Governor's School, June 18, 2018</li> <li>◊ APSU Governor's School, June 15, 2018; June 16, 2017; June 17, 2016; and June 12, 2015</li> <li>◊ McCalie School (8th grade), May 9, 2018; May 10, 2017</li> <li>◊ Brevard College Tour, Sept, 2017</li> <li>◊ UAH Joint Space Weather Summer Camp, June 30, 2017</li> <li>◊ University of Louisville's Society of Physics Students, March 15, 2017</li> <li>◊ White House High, April 7, 2016</li> <li>◊ Lipscomb Academy, Oct. 1, 2015</li> </ul> </li> </ul>

TEACHING  
EXPERIENCE      **Oak Ridge Institute for Continued Learning** at Roane State Community College, Oak Ridge, Tennessee, USA

*Co-lecturer with Dr. Melissa R. Allen (ORNL)*

Climate Change Science

**June 2016**

We presented four lectures, one and a quarter hours in length, on the topics: 1) global warming and the carbon cycle, 2) indicators of climate change, 3) impacts of climate change on human life and 4) global and regional climate modeling and uncertainty.

**University of Alaska Fairbanks**, Fairbanks, Alaska, USA

*Graduate Teaching Assistant*

Geology & Geophysics Department

**August 2014 – December 2014**

I taught the computational portion of the graduate level geophysics course Foundations of Geophysics and was responsible for lectures, homework assignments, and grades. Further duties included holding weekly office hours.

- ◊ GEOS 631/431 – Foundations of Geophysics, Fall 2014

*Guest Lecturer*

GEOS 631/431 — Foundations of Geophysics (Oct. 25 and Oct. 30, 2012): I gave two lectures, one and a half hours in length, on general conservation laws, conservation of energy, and heat transfer. The first lecture started with the general form of the conservation laws, derived the conservation of momentum equation the students were familiar with, and then discussed the definition and forms of energy. The lecture concluded with a discussion on the first law of thermodynamics as well as a derivation of the conservation of energy equation. The second lecture discussed Fourier's law and solved practical heat flow problems; some of which were taken from Chapter 4 of Turcotte and Schubert's Geodynamics textbook.

*Guest Lecturer*

GEOS 636/436 — Beyond the Mouse: Computer Programming and Automation for Geosciences (Sept. 11 and Nov. 15, 2012): The September lecture was 1 hour in length and focused on an introduction to variables and data types. We discussed what a computer is, how a computer thinks, what a program is, and what a programming language is. The students were then taught how to create variables and store different types of data. The November lecture was a demonstration of live programming and was 2 hours in length. I demonstrated how to use common command line tools, a scripting language, and good file structure to create a manuscript preparation work-flow. I developed scripts to help create a L<sup>A</sup>T<sub>E</sub>X document and introduced tools such as a distributed version control system to keep track of changes and share work with collaborators.

*Graduate Teaching Assistant*

Geology & Geophysics Department

**August 2012 – December 2012**

I taught the computational portion of graduate level geophysics courses and was responsible for lectures, homework assignments, and grades. Further duties included holding weekly office hours.

- ◇ GEOS 631/431 — Foundations of Geophysics, Fall 2012
- ◇ GEOS 636/436 — Beyond the Mouse: Computer Programming and Automation for Geosciences, Fall 2012

*NSF GK-12 Fellow*

Denali Elementary School

**May 2011 – May 2012**

I taught 4 science lessons a week in two first grade classrooms of 30 students (10 contact hours per week). We covered a variety of subjects, including: the scientific method, the five senses, plants, birds of prey, migratory birds, caribou, weather, glaciers, heat transfer, food science, rockets, pressure-volume-temperature, volcanoes and how to design a testable question. I primarily designed the lesson plans, homework, and experiments for the students. At the end of the year, the classes worked on a joint science fair project in which the students designed and conducted the entire experiment. The classes won a first place ribbon and a \$50.00 prize for *Exceptional Women in Science* at the Fairbanks Northstar Borough School District Science Fair.

*Graduate Teaching Assistant*

Physics Department

**August 2008 – May 2009**

I taught the laboratory portion of introductory physics courses and was responsible for lectures, homework assignments, and grades. Further duties included holding weekly office hours and staffing the homework help office.

- ◇ PHYS 103 – College Physics I, Fall 2008, 2 sections
- ◇ PHYS 104 – College Physics II, Spring 2009
- ◇ PHYS 115 – Physical Science I, Spring 2009

**Western Washington University, Bellingham, Washington, USA**

*Undergraduate Teaching Assistant*

**September 2006 – June 2008**

I taught the laboratory portion of the introductory physics courses and was responsible for lectures, homework assignments and grades.

- ◇ PHYS 131 — Physics with Calculus I Lab, Fall 2006, 2007
- ◇ PHYS 132 — Physics with Calculus II Lab, Winter 2007, 2008
- ◇ PHYS 133 — Electricity and Magnetism Lab, Spring 2007, 2008

INVITED TALKS

*Kennedy, J.H.*, K.J. Evans, A.R. Bennett, P. Worley, S. Price, M. Hoffman

Evaluating the performance of ice sheet models using LIVVkit

Minisymposium on numerical methods towards next generation ice sheet models

SIAM Conference on Mathematical and Computational Issues in the Geosciences

Erlangen, Germany, Sept. 11, 2017

*Kennedy, J.H.*

Climate change today: An overview of the science, the observations, and a look toward the future

TENS: The Executive Network of Seattle, Seattle, Washington, January 16, 2017

*Kennedy, J.H.*, M.R. Allen

Climate change overview

League of Women Voters of Oak Ridge, Oak Ridge, Tennessee, February 16, 2016

*Kennedy, J.H.*

Glacier modeling in < 10 minutes

CCSI Earth System Modeling Workshop, Oak Ridge National Laboratory, June 9, 2015

*Kennedy, J.H.*

A closer look at the link between climate history and fabric evolution in ice sheets

MicroDice Ice Flow Workshop, Nuuk, Greenland, August 22, 2011

Pettit, E.C., A. Gusmeroli, *J.H. Kennedy*  
 Exploring the link between climate history and fabric evolution in ice sheets  
 Laboratoire de Glaciologie et Gophysique de l'Environnement, Grenoble, France, April 12, 2011

*Kennedy, J.H.*  
 Climate signal evolution in crystal orientation fabric  
 Physics Department Colloquium, Western Washington University, Bellingham, WA, October 21, 2010

CONFERENCE  
 PRESENTATIONS  
 (LAST 5 YRS)

*Kennedy, J.H.*, et al.  
 A Look at the challenges of, and some solutions to, evaluating next-generation Earth system models  
 6th European Seminar on Computing (ESCO), June 6, 2018

*Kennedy, J.H.*, et al.  
 A tour of ORNL's Earth system model assessment tools  
 ORNL Software Expo, May 16, 2018

*Kennedy, J.H.*, et al.  
 Using the LIVVkit 2.0+ validation infrastructure  
 22<sup>nd</sup> Annual CESM Workshop, June 19, 2017

*Kennedy, J.H.*, et al.  
 Climate reproducibility testing with EVE  
 ACME all-hands meeting, June 5, 2017

*Kennedy, J.H.*, et al.  
 PISM-FEvoR: a multi-scale ice flow model incorporating fabric evolution with recrystallization  
 SIAM Conference on Computational Science and Engineering, MS243, March 2, 2017

*Kennedy, J.H.*, et al.  
 LIVVkit 2: A robust and extensible python package for ice-sheet model verification and validation  
 AMS Annual Meeting, Seventh Symposium on Advances in Modeling and Analysis Using Python, January 24, 2017

*Kennedy, J.H.*, et al.  
 LIVVkit 2: An extensible land ice verification and validation toolkit for comparing observations and models  
 AGU Fall Meeting, Abstract GC21A-1051, December 13, 2016

*Kennedy, J.H.*, et al.  
 Full-system evaluation of Earth system models  
 Advancing X-cutting Ideas for Computational Climate Science, September 12, 2016

*Kennedy, J.H.*, et al.  
 Building LIVVkit  
 CCSI Earth System Modeling Workshop, August 16, 2016

*Kennedy, J.H.*, et al.  
 Developing LIVVkit  
 Oak Ridge Postdoc Association Research Symposium, August 8, 2016

*Kennedy, J.H.*, et al.  
 An introduction to LIVVkit 2.0  
 21<sup>st</sup> Annual CESM Workshop, June 22, 2016

*Kennedy, J.H.*, et al.  
 LIVVkit now and into the future: A discussion  
 Land Ice Working Group Meeting, February 10, 2016

*Kennedy, J.H.*, et al.  
 Building confidence in the community ice sheet model (CISM) with LIVVkit, the land-ice validation and verification toolkit  
 AGU Fall Meeting, Abstract C51C-0741, December 18, 2015

*Kennedy, J.H.*, et al.

LIVV awakens: A toolkit for land ice verification and validation  
20<sup>th</sup> Annual CESM Workshop, June 17, 2015

*Kennedy, J.H.*, et al.

The record may be in the fabric: Preservation of climate history in polar ice sheets  
AGU Fall Meeting, Abstract C52B-08, December 13, 2013

FIELD WORK	<p><b>Dome C, East Antarctica.</b> Deploying a sonic probe down the Dome C ice core borehole and prepping ice core samples. 3 weeks.</p> <p><b>Valdez, AK, USA.</b> Deploying sea temperature moorings. 3 days.</p> <p><b>Yakutat Glacier, AK, USA.</b> Taking GPS measurements, ablation stake measurements, and deploying time laps cameras. 5 days.</p> <p><b>Icy Bay, AK, USA.</b> Deploying hydro-acoustic mooring, taking CDT casts, and hydro-acoustic recordings. 5 days.</p>	
AFFILIATIONS	APS	American Physical Society
	IGS	International Glaciological Society
	AGU	American Geophysical Union
COMPUTER SKILLS	Operating Systems:	Unix/Linux, Windows, OSX
	Languages:	Python, C/C++, FORTRAN, Bash, $\text{\LaTeX}$
	Mathematics Packages:	MATLAB, Mathematica, Octave
	Data science:	netCDF4, HDF5, NCO, NCL, Anaconda, R, Gnuplot
	Web:	Apache, PHP, HTML, CSS, Drupal
	Applications:	Mendeley, Adobe Creative Suite, Microsoft Office
OTHER SKILLS AND ACTIVITIES	<ul style="list-style-type: none"><li>◇ Wilderness experience including a continuous 700 mile, 33 day, canoe trip down the Yukon River</li><li>◇ Skilled with soldering, hand and power tools, and simple electrical systems</li><li>◇ Extensive boat experience: sailing, canoeing, power-boating, etc.</li><li>◇ Enjoy outdoor recreation: biking, hiking, backpacking, camping, etc.</li><li>◇ Trained in bear safety</li></ul>	