Andrew E. Slaughter

andrew.e.slaughter@gmail.com

Fuel Modeling and Simulation
Idaho National Laboratory
P.O. Box 1625
Idaho Falls, ID 83415
208.526.6888

Education

PhD in Engineering, Applied Mechanics Option   Apr. 2010
Montana State University (MSU), Bozeman, MT

MS in Civil Engineering   Aug. 2004
Washington State University (WSU), Pullman, WA

BS in Civil Engineering   Aug. 2002
Michigan Technological University (MTU), Houghton, MI

Experience

Research and Development Scientist/Engineer, Level 2   Apr. 2013–present
Idaho National Laboratory, Fuel Modeling and Simulation
Idaho Falls, ID

National Science Foundation (NSF) Post-doctoral Fellow   Sept. 2011–Mar. 2013
Cornell University, Sibley School of Mechanical and Aerospace Engineering
Materials Process Design and Control Laboratory (MPDC)
Ithaca, NY

Adjunct Faculty   Aug. 2010–May 2011
Montana State University, Department of Civil Engineering
Bozeman, MT

Postdoctoral Fellow   May 2010–Aug. 2010
Montana State University, Department of Civil Engineering
Montana Space Grant Consortium Montana NASA EPSCoR Research Initiation
Bozeman, MT

Instructor   Aug. 2009–Dec. 2009
Montana State University, Department of Civil Engineering
Bozeman, MT

Academic Experience

NSF Graduate Teaching Fellow in K–12 Education (GK–12)   July 2007–July 2009
Montana State University, Department of Civil Engineering and Big Sky Institute
Bozeman, MT

Inland Northwest Research Alliance Graduate Fellow   Aug. 2005–July 2007
Montana State University, Department of Civil Engineering
Bozeman, MT

Graduate Teaching Assistant   Aug. 2004–May 2005
Montana State University, Department of Civil Engineering
Bozeman, MT

Weyerhaeuser Graduate Fellow   Aug. 2002–July 2004
Washington State University, Department of Civil and Environmental Engineering
Composite Materials and Engineering Center
Pullman, WA

Engineering Technician May 2002–Aug. 2002
Indian Health Servic
Harlem, MT

Grants Received

NSF 1049501; P.I. Andrew E. Slaughter; $170,000 Sept. 2011–Aug. 2013
Title: *A Stochastic Phase-tracking Snow Micro-structure Model*
National Science Foundation, Division of Earth Sciences, Postdoctoral Fellowship Program
> The goal of the work is to research the use of stochastic finite element methods to model the evolution of the snow micro-structure including phase change within the snow. A model of this type would improve the current understanding of snow metamorphism by providing a means to monitor the evolution of the ice matrix within the snow while accounting for uncertainties.

Summary of Research Projects

National Science Foundation Post-doctoral Fellow (CU)
Proposal Title: *A Stochastic Phase-tracking Snow Micro-structure Model*
- Researching a stochastic 3-D, phase-tracking finite element model of snow micro-structure that:
  - utilizes optimized methods to solve the level set equation for tracking phase-change front,
  - solves the mass, momentum, and energy equations with micro-convection at the phase interface, and
  - implements parallel, adaptive domain decomposition solvers for efficient computation
- Improving the collaborative tools at the MPDC: confluence.cornell.edu/display/mpdc/Home
- Developing a web-based outreach tool to make resulting research widely accessible

Post-doctoral Researcher (MSU)
Project: *Snow Near Surface Morphologies and Influence on Solar Albedo*
- Assisted in development of techniques for measuring and analyzing the bi-direction reflectance distribution function of snow in the visible and near-infrared wavelengths
- Co-authored the project final report
- Developed open-source image analysis software: Snow Optics Toolbox

PhD Research (MSU)
Dissertation: *Numerical Analysis of Conditions Necessary for Near-surface Snow Metamorphism*
- Utilized SOBOL sensitivity analysis and a finite-difference heat-transfer model to isolate important factors in near-surface metamorphism
- Performed laboratory simulations of near-surface facet metamorphism
- Established collaborative, ongoing research program with local ski resort and ski patrol
- Designed, implemented, and distributed various open-source software packages including a collaborative database system: YCweather

MS Research (WSU)
Thesis: *Design and Fatigue of a Structural Wood-Plastic Composite*
- Designed, tested, and implemented wood-plastic composite bridge decking for pedestrian bridge structures
- Oversaw installation, testing, and reporting of a custom composite column connection

Senior Design (MTU)
Project: Eagle River Bridge Restoration Project
- Analyzed a closed 1909 truss bridge for design capacity and proposed retrofitting scheme

Teaching Experience

Courses Developed and Instructed

Snow and Avalanche Physics for Science Educators (MSU, ECIV591). 3 credits. Establishes the necessary background for understanding snow and avalanches, methods for solving problems related to snow and avalanche mitigation including topics from route selection to explosives placement, and basics of snow and avalanche physics. *Semesters: S2011, F2010*

Courses Instructed

Mechanics (MSU, EM205). 3 credits. Covers topics such as force systems in equilibrium and applications to structural trusses and frames, section properties, distributed force systems, shear and moment distributions in beams, and basic particle dynamics.Covers topics such as force *Semesters: F2009*

Strength of Materials (MSU, EM215). 3 credits. Includes topics such as equilibrium and deformation of structural elements; concepts of stress and strain and interrelationship; representation and transformation of combined stress states; axial, torsional, and flexural stresses and deformation; and column buckling. *Semesters: S2011*

Texts and Critics: Knowledge (MSU, UH201US). 4 credits. University Seminar in critical reading/analysis of fundamental texts in the humanities, arts, communication, social studies, science, and history of ideas. Follows Socratic teaching methodology. Particular emphasis on development of analysis and criticism through argument, writing, and oral communication. Includes academic writing and oral argumentation presentations. *Semesters: F2010*

Courses Serving as Teaching Assistant

Finite Element Analysis for Mechanical and Aerospace Design (CU, MAE4700/5700). 3–4 credits. Introduction to linear finite element static and dynamic analysis for discrete and distributed mechanical and aerospace structures. Prediction of load, deflection, stress, strain, and temperature distributions. Major emphasis on underlying mechanics and numerical methods. Introduction to computational aspects via educational and commercial software. *Semesters: F2011, F2012*

Mechanics (MSU, EM205). 3 credits. Covers topics such as force systems in equilibrium and applications to structural trusses and frames, section properties, distributed force systems, shear and moment distributions in beams, and basic particle dynamics.Covers topics such as force *Semesters: S2010*

Applied Mechanics of Fluids (MSU, EM331). 3 credits. Introduces basic principles of fluid mechanics: pressure measurement, forces on submerged areas, fluid flow through conduits, parallel pipe systems, open channel flow, forces caused by fluids in motion, pumps, and flow of air in ducts. *Semesters: F2010, F2004*

Concrete Technology and Structures (MSU, CE310). 3 credits. Covers properties of concrete constituents, mechanical and service properties of concrete, mix design, and field practices, as well as concrete reinforcing requirements and analysis of concrete members. *Semesters: S2005*

Outreach and Education Activities

Graduate Teaching Fellow in K–12 Education (GK–12)   July 2007–July 2009
National Science Foundation and Big Sky Institute, Bozeman, MT
- Partnered with a teacher to expand curriculum to foster excitement in science, technology, engineering, and mathematics education
- Instructed elementary science on topics including snow physics and structural engineering

Research and Engineering Apprenticeship Program (REAP)   Summers 2006–2008
Montana State University, Bozeman, MT
- Mentored recent high school graduates in conducting research at MSU
- Guided students on projects researching snow micro-penitents and snow albedo

Avalanche Field Course Instructor   2009–2011
Gallatin National Forest Avalanche Center, Bozeman, MT
- Instructed half-day basic avalanche field courses for community members and Montana State University students

Science Storms   2009
Museum of Science and Industry, Chicago, IL
- Assisted in the development of an interactive game that explores snow avalanches

Presentation: "Is it Safe?"   Sept. 2008
International Snow Science Workshop, Whistler, BC
- Organized a presentation developed by 2007/2008 5th grade students, which was accepted and presented at the International Snow Science Workshop by student representatives
- Independently raised travel funds for the student presenters
- Featured in various regional news outlets via the MSU News Service

National, Regional, and Local News Appearances
- Involved in various local news stories of research conducted at Montana State University
- Appeared in the New York Times: *Solving Avalanches' Mysteries*
- Appeared on the Discovery Channel: *Survive This, Smokey Bear Balloon Crash*

Computer and Technical Skills

Programming and Software Development Skills
Accomplished in building end-user software applications, graphical user interfaces, and code documentation ■ Proficient in parallel programming and various open-source finite element frameworks ■ Skilled with numerous visualization and meshing interfaces ■ Well versed with Windows and Linux operating systems, office software applications, and manuscript typesetting tools ■ Experienced with a wide variety of programming languages and development tools:

- C++
- MATLAB
- Fortran
- Python
- GNU Octave
- R
- HTML

- LabView
- MathCAD
- PETSc
- libMesh
- FEniCS
- Cmake
- Doxygen

- Git
- SVN
- Mercurial
- VTK
- ITK
- ImageMagick++
- CGAL

- ParaView
- EnSight
- LaTeX
- MS Office Suite
- Libre/OpenOffice
- Adobe Suite

Laboratory and Technical Skills
Proficient with the use of environmental instrumentation including pyranometers and infrared radiometers ■ Skilled with data recording and management including National Instruments and Agilent systems ■ Experienced with structural testing equipment including fatigue-rated servo-hydraulic actuators ■ Practiced with a wide variety of machine and wood working equipment

Open-source Software Developed

mFEM: An Object-Oriented MATLAB Finite Element Library
- Designed for education and rapid problem solving
- Includes automatic assembly routines
- Support for continuous, discontinuous, and vector finite elements

YCweather: Weather and Snow Observations Database
- A tool for organizing and accessing weather data and field observations of snow
- Part of an on-going collaboration between MSU, the Yellowstone Club Ski Patrol, and the Gallatin National Forest Avalanche Center
- Includes automatic updates of software and data
- Used to produce results for numerous publications and presentations [2, 3, 4, 10, 11]

Snow Optics Toolbox: A Tool for Image Analysis and Comparison
- A set of MATLAB programs for viewing and analyzing images of snow
- Developed for the study of the Bidirectional Reflectance Distribution Function [6]

Snow Thermal Model: A MATLAB Based Finite Difference Model
- Finite-difference snow thermal model that was the basis of my PhD research
- Includes command-line, Excel, and GUI interfaces
- Used extensively for various publications and presentations [4, 16]

Fellowships and Scholarships

National Science Foundation GK-12 Graduate Fellowship (Jul. 2007 and Jul. 2008)
B.E. Grant Memorial Scholarship (Aug. 2007)
Inland Northwest Research Alliance Graduate Fellowship (Aug. 2005 and Aug. 2006)
Kenneth Tait Scholarship (Aug. 2005 and Aug. 2006)
American Avalanche Association Graduate Grant (Sept. 2005)
International Snow Science Workshop 2000 Graduate Grant (Sept. 2005)
Washington State University Graduate Scholarship (Jan. 2003)
Weyerhaeuser Graduate Fellowship (Aug. 2002)

List of Publications

Peer-reviewed Journal Articles

[1] D.R. Gaston, C.J. Permann, J.W. Peterson, **A.E. Slaughter**, D. Andrs, Y. Wang, M.P. Short, D.M. Perez, M.R. Tonks, J. Ortensi, and R.C. Martineau. Physics-based multiscale coupling for full core nuclear reactor simulation. *Annals of Nuclear Energy*, in review.

[2] **A.E. Slaughter**, E.E. Adams, P.J. Staron, R.H. Shertzer, D.J. Walters, D. McCabe, D. Catherine, I. Henninger, T. Leonard, M. Cooperstein, and H. Munter. Field investigation of near-surface metamorphism of snow. *Journal of Glaciology*, 57(203):441–452, 2011.

[3] E.E. Adams, **A.E. Slaughter**, L.R. McKittrick, and D.A. Miller. Local terrain topography and thermal properties influence on energy and mass balance of a snowcover. *Annals of Glaciology*, A52(58):169–175, 2011.

[4] **A.E. Slaughter**, D. McCabe, H. Munter, P.J. Staron, E.E. Adams, D. Catherine, I. Henninger, M. Cooperstein, and T. Leonard. An investigation of radiation-recrystallization coupling laboratory and field studies. *Cold Regions Science and Technology*, 59(2–3):126–132, 2009.

[5] **A.E. Slaughter**, M.P. Wolcott, and D.I. McLean. Design of a wood-plastic composite bridge deck member. *Forest Products Journal*, accepted.

Technical Reports

[6] D.A. Miller, **A.E. Slaughter**, and B.T. Stanton. Snow near surface morphologies and influence on solar albedo. Final report, Montana Space Grant Consortium Montana NASA EPSCoR Research Initiation, Grant 4W2994, August 2011.

Proceedings and Presentations

[7] D.R. Gaston, J.W. Peterson, C.J. Permann, D. Andrs, **A.E. Slaughter**, and J.M. Miller. Continuous Integration for Concurrent Computational Framework and Application Development. In *SC13: Workshop on Sustainable Software for Science: Practice and Experiences*. Denver, CO, 2013.

[8] R. Williamson, J. Hales, S. Novascone, B. Spencer, D. Perez, G. Pastore, P. Medvedev, D. Gaston, C. Permann, D. Andrs, **A. Slaughter**, and R. Martineau. BISON: Nuclear fuel performance code. In *American Nuclear Society: LWR Fuel Performance Meeting*. Charlotte, NC, 2013.

[9] **A.E. Slaughter** and N. Zabaras. A phase-tracking snow micro-structure model. In *International Snow Science Workshop*. Anchorage, AK, 2012.

[10] **A.E. Slaughter** and E.E. Adams. Field and analtyical examination of near-surface facets. In *International Snow Science Workshop*. Sqauw Valley, CA, 2010.

[11] E.E. Adams, **A.E. Slaughter**, L. McKittrick, and D.A. Miller. The coupling of snow near surface metamorphism and surface energy balance in complex alpine terrain. In *International Symposium on Snow, Ice and Humaity in a Changing Climate*. Sapporo, JP, 2010.

[12] **A.E. Slaughter** and E.E. Adams. Numerical investigation of factors causing near-surface metamorphism. In *International Snow Science Workshop*. Davos, CH, 2009.

[13] E. Adams, L McKittrick, **A.E. Slaughter**, P. Staron, R. Shertzer, D. Miller, T. Leonard, D. McCabe, I. Henninger, D. Catharine, M. Cooperstein, and K. Laveck. Modeling variation of surface hoar and radiation recrystallization across a slope. In *International Snow Science Workshop*. Davos, CH, 2009.

[14] **A.E. Slaughter** and E.E. Adams. Importance and interaction of the energy balance components governing radiation-recrystallization of snow. In *Lessons from Continuity and Change in the Fourth International Polar Year*, 2009.

[15] Staron P.J., E.E. Adams, and **A.E. Slaughter**. Modeling and measuring albedo due to near-surface metamorphism. In *Lessons from Continuity and Change in the Fourth International Polar Year*, 2009.

[16] **A.E. Slaughter**, P.J. Staron, E.E. Adams, D. McCabe, H. Munter, D. Catherine, I. Henninger, M. Cooperstein, and T. Leonard. Laboratory simulations of radiation-recrystallization events in Southwest Montana. In *International Snow Science Workshop*. Whistler, BC, 2008.

[17] **A.E. Slaughter**, D.T. Neal, and Ophir School 2007/2008 Fifth Grade. Snow science as curriculum in a fifth grade classroom. In *International Snow Science Workshop*. Whistler, B.C., 2008.

[18] Ophir School 2007/2008 Fifth Grade, **A.E. Slaughter**, and D.T. Neal. Is it safe? An educational poster developed by grade school students for their peers. In *International Snow Science Workshop*. Whistler, B.C., 2008.

[19] D. McCabe, H. Munter, D. Catherine, I. Henninger, M. Cooperstein, T. Leonard, **A.E. Slaughter**, P.J. Staron, and E.E. Adams. Near-surface faceting on south aspects in Southweast Montana. In *International Snow Science Workshop*, pages 147–154. Whistler, B.C., 2008.

[20] **A.E. Slaughter**, E.E. Adams, T. Weas, and M. Hanson. Growth of snow mirco-penitents under controlled laboratory conditions. In *Environmental and Subsurface Science Symposium*. Moscow, ID, 2006.

[21] J.M. Staples, E.E. Adams, **A.E. Slaughter**, and L.R. McKittrick. Slope scale modeling of snow surface temperature in topographically complex terrain. In *International Snow Science Workshop*, pages 806–814. Telluride, CO, 2006.

[22] **A.E. Slaughter**, M.P. Wolcott, and D. McLean. Design of a wood-plastic composite deck board. In *Transportation Research Board 84th Annual Meeting*, 2005.

Professional References

Prof. Edward Adams, *PhD Advisor*
205 Cobleigh Hall, Montana State University, Bozeman, MT 59717
eda@ce.montana.edu (406.994.6122)

Prof. Dan Miller, *Postdoctoral Supervisor*
205 Cobleigh Hall, Montana State University, Bozeman, MT 59717
dan.miller@ce.montana.edu (406.994.6118)

Prof. Michael Wolcott, *MS Advisor*
Composite Materials and Engineering Center, PO Box 641806, Washington State University,
Pullman, WA 99164-1806
wolcott@wsu.edu (509.335.6392)