ED BUELER

Associate Professor of Mathematics (Applied)
Department of Mathematics and Statistics
and Geophysical Institute
University of Alaska
Fairbanks, AK 99775-6660

(907) 474–7693
elbueler@alaska.edu
www.dms.uaf.edu/∼bueler

Academic Positions

Associate Professor, DMS, UAF August 2005–present.[1]
Assistant Professor, DMS, UAF August 2000–May 2005.
Term Assistant Professor, DMS, UAF August 1998–May 2000.
Postdoctoral Fellow, *Year in Stochastic Analysis*, Mathematical Sciences Research Institute, Berkeley, August 1997–May 1998.

Education

Ph. D. Mathematics, Cornell University, Ithaca NY, 1997. (advisor: Leonard Gross; thesis: *The heat kernel weighted Hodge Laplacian on noncompact manifolds*)
M. S. Mathematics, Cornell University, Ithaca NY, 1994.
B. S. Mathematics with Honors, Minor in Physics, Minor in Electrical Engineering, California State University, Chico CA, 1991.

Honors

Faculty Advising Award for Outstanding Undergraduate Advising, 2003-2004.
Honorary Faculty Certificate of Appreciation for support of a student-athlete, 2004.
Bonus for Extraordinary Performance, CSEM, 2003.

Publications (peer-reviewed)

P22. S. Nowicki and 30 others including E. **Bueler** 2013. *Insights into spatial sensitivities of ice mass response to environmental change from the SeaRISE ice sheet modeling project II: Greenland*, J. Geophys. Res. (Earth Surface), doi:10.1002/jgrf.20076.
P21. S. Nowicki and 30 others including E. **Bueler** 2013. *Insights into spatial sensitivities of ice mass response to environmental change from the SeaRISE ice sheet modeling project I. Antarctica*, J. Geophys. Res. (Earth Surface), doi:10.1002/jgrf.20081.
P20. G. Jouvet, E. **Bueler**, C. Gräser, and R. Kornhuber, 2013. *A nonsmooth Newton multigrid method for a hybrid, shallow model of marine ice sheets*, AMS Contemporary Mathematics (SCA 2012) 586, 197–205
P19. G. Jouvet and E. **Bueler**, 2012. *Steady, shallow ice sheets as obstacle problems: well-posedness and finite element approximation*, SIAM J. Appl. Math. 72 (4), 1292–1314
P18. A. Aschwanden, E. **Bueler**, C. Khroulev, and H. Blatter, 2012. *An enthalpy formulation for glaciers and ice sheets*, Journal of Glaciology 58 (209), 441–457

[1] CV date: May 13, 2013

P17. F. Pattyn, C. Schoof, and 16 others including E. **Bueler**, 2012. *Results of the Marine Ice Sheet Model Intercomparison Project, MISMIP*, The Cryosphere 6, 573–588

P16. M. A. Martin, R. Winkelmann, M. Haseloff, T. Albrecht, E. **Bueler**, C. Khroulev, and A. Levermann, 2011. *The Potsdam Parallel Ice Sheet Model (PISM-PIK)–Part 2: Dynamic equilibrium simulation of the Antarctic ice sheet*, The Cryosphere 5, 727–740.

P15. R. Winkelmann, M. A. Martin, M. Haseloff, T. Albrecht, E. **Bueler**, C. Khroulev, and A. Levermann, 2011. *The Potsdam Parallel Ice Sheet Model (PISM-PIK)–Part 1: Model description*, The Cryosphere 5, 715–726.

P14. G. Jouvet, J. Rappaz, E. **Bueler**, and H. Blatter, 2011. *Existence and stability of steady state solutions of the shallow ice sheet equation by an energy minimization approach*, Journal of Glaciology 57 (202), 345–354.

P13. R. Calov, R. Greve, A. Abe-Ouchi, E. **Bueler**, P. Huybrechts, J. V. Johnson, F. Pattyn, D. Pollard, C. Ritz, F. Saito, and L. Tarasov, 2010. *Results from the Ice-Sheet Model Intercomparison Project-Heinrich Event INtercOmparison (ISMIP–HEINO)*, Journal of Glaciology 56 (197), 371–383.

P12. E. **Bueler** and J. Brown, 2009. *Shallow shelf approximation as a "sliding law" in a thermomechanically coupled ice sheet model*, Journal of Geophysical Research (Earth Surface) 114, F03008, doi:10.1029/2008JF001179.

P11. E. A. Butcher, M. Sari, E. **Bueler**, and T. Carlson, 2009. *Magnus' expansion for time-periodic systems: parameter-dependent approximations*, Communications in Nonlinear Sciences and Numerical Simulation 14, 4226–4245.

P10. E. A. Butcher, O. A. Bobrenkov, E. **Bueler**, and P. Nindujarla, 2009. *Analysis of milling stability by the Chebyshev collocation method: Algorithm and optimal stable immersion levels*, Journal of Computational and Nonlinear Dynamics (ASME) 4 (3), 031003.

P9. V. Deshmukh, E. A. Butcher, and E. **Bueler**, 2008. *Dimensional reduction of nonlinear delay differential equations with periodic coefficients using Chebyshev spectral collocation*, Nonlinear Dynamics 52, 137–149.

P8. E. **Bueler**, 2007. *Error bounds for approximate eigenvalues of periodic-coefficient linear delay differential equations*, SIAM Journal on Numerical Analysis 45 (6), 2510–2536.

P7. E. **Bueler**, J. Brown, and C. Lingle, 2007. *Exact solutions to the thermomechanically coupled shallow ice approximation: effective tools for verification*, Journal of Glaciology 53 (182), 499–516.

P6. E. **Bueler**, C. S. Lingle, and J. A. Brown, 2007. *Fast computation of a viscoelastic deformable earth model for ice flow simulations*, Annals of Glaciology 46, 97–105.

P5. E. **Bueler**, C. S. Lingle, J. A. Kallen-Brown, D. N. Covey, and Latrice N. Bowman, 2005. *Exact solutions and the verification of numerical models for isothermal ice sheets*, Journal of Glaciology 51 (173), 291–306.

P4. E. A. Butcher, H. Ma, E. **Bueler**, V. Averina, and Z. Szabo, 2004. *Stability of time-periodic delay-differential equations via Chebyshev polynomials*, International Journal on Numerical Methods in Engineering 59 (7), 895–922.

P3. E. A. Butcher, H. Ma, and E. **Bueler**, 2003. *Chebyshev expansion of linear dynamic systems with time delay and periodic coefficients under control excitations*, Journal of Dynamic Systems, Measurement and Control (ASME) 125, 236–243.

P2. E. **Bueler** and I. Prokhorenkov, 2002. *Hodge theory and cohomology with compact supports*, Soochow Journal of Mathematics 28 (1), 33–55.

P1. E. **Bueler**, 1999. *The heat kernel weighted Hodge Laplacian on noncompact manifolds*, Transactions of the American Mathematical Society 351, 683–713.

Editor-reviewed Publications

C6. W. Lipscomb, R. Bindschadler, E. **Bueler**, D. Holland, J. Johnson, and S. Price, *Building a Next-Generation Community Ice Sheet Model*, Eos Transactions, AGU, 90 (3), 23.
C5. E. **Bueler**, *Lessons from the short history of ice sheet model intercomparison*, The Cryosphere Discussions 2, 1–14, 2008.
C4. E. A. Butcher, V. Deshmukh, and E. **Bueler**, *Center manifold reduction of periodic delay differential systems*, Proceedings of the ASME IDETC/CIE, 2007.
C3. E. A. Butcher, P. Nindujarla and E. **Bueler**, *Stability of up- and down-milling using a Chebyshev collocation method*, Proceedings of ASME IDETC/CIE, 2005.
C2. V. Averina and four others, *Effect of delay on engine air-to-fuel ratio control*, Proceedings of the IEEE Conference on Control Applications, Toronto, 2005.
C1. E. A. Butcher and four others, *Stability analysis of parametrically excited systems with time-delay*, Proceedings of ASME DETC, 2003.

Technical Reports

T11. E. **Bueler** and J. Brown, *The shallow shelf approximation as a "sliding law" in a thermomechanically coupled ice sheet model*, `arXiv:0810.3449`, 2008.
T10. E. **Bueler**, *An exact solution to the temperature equation in a column of ice and bedrock*, `arXiv:0710.1314`, 2007.
T9. E. **Bueler** and J. Brown, *On exact solutions for cold, shallow, and thermocoupled ice sheets*, `arXiv:physics/0610106`, 2006.
T8. E. **Bueler**, C. S. Lingle, and J. Brown, *Computation of combined spherical-elastic and viscous-half-space earth model for ice sheet simulation*, `arXiv:physics/0606074` (2006).
T7. E. **Bueler**, *Chebyshev collocation for linear, periodic ordinary and delay differential equations:* a posteriori *estimates*, `arXiv:math.NA/0409464` (2004).
T6. E. **Bueler**, C. S. Lingle, J. Brown, D. Covey, and L. N. Bowman, *Exact time-dependent similarity solutions for isothermal shallow ice sheets*, UAF DMS Tech. Rep. 04–01 (2004).
T5. E. **Bueler**, *Construction of steady state solutions for isothermal shallow ice sheets*, UAF DMS Tech. Rep. 03–02 (2003).
T4. E. **Bueler** and E. A. Butcher, *Stability of periodic linear delay–differential equations and the Chebyshev approximation of fundamental solutions*, UAF DMS Tech. 02–03 (2002).
T3. E. **Bueler**, *Numerical approximation of a two dimensional thermomechanical model for ice flow*, UAF DMS Tech. Rep. 02–02 (2002).
T2. E. **Bueler**, *Dirac operators as "annihilation operators" on Riemannian manifolds*, (2001).
T1. E. **Bueler**, *Number operators for Riemannian manifolds*, `arXiv:math-ph/0104022` (2000).

Computer Programs

Parallel Ice Sheet Model (PISM):

`www.pism-docs.org`

PISM is open-source and free. Its major authors are E. **Bueler** (both programmer and Principal Investigator), C. Khroulev, J. Brown, D. Maxwell, T. Albrecht, and A. Aschwanden.

It is co-developed with the Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany, but the majority ($\sim 90\%$) of the code and all of the user support and documentation is through UAF. Since 2007 there have been 20 publications on applications of, and design of, PISM. We have significant collaboration with researchers at the following institutions:

- Danish Climate Centre, Danish Meteorology Institute, Copenhagen, Denmark
- Centre for Ice and Climate, U. Copenhagen, Denmark
- Max Planck Institute for Meteorology, Hamburg, Germany
- Institute for Marine and Atmospheric Research, Utrecht, Netherlands
- Victoria University, Wellington, New Zealand

PISM has more than 50,000 lines of source code, the majority of which is C++ code. It is fully-parallelized using the PETSc library. There are PDF *User's*, *Climate Forcing* and *Installation Manuals* totalling about 200 pages, plus an extensive developer's website.

DDEC. Author E. **Bueler**. This is a suite of *Matlab* programs for stability charts of linear periodic delay differential equations: `www.dms.uaf.edu/~bueler/DDEcharts.htm`

Funded Research Grants

E. **Bueler** (PI), M. Fahnestock (Co-I), A. Aschwanden (Co-I), *Understanding Measured Variability in the Greenland Ice Sheet Using the Parallel Ice Sheet Model (PISM)*, NASA Modeling Analysis and Prediction Program, June 2013 –June 2014. Award of $737k over 4 years.

E. **Bueler** (PI), R. Hock (Co-I), D. Maxwell (Co-I), and M. Truffer (Co-I), *A high resolution Parallel Ice Sheet Model including fast, sliding flow: advanced development and application*, NASA Modeling Analysis and Prediction Program grant #NNX09AJ38G, June 2009–June 2013. Award of $997k over 4 years.

C. Lingle (PI), D. Covey (Co-I), and E. **Bueler** (Co-I), *Ice Sheet Modeling: a component of NSF grant PRISM: Polar Radar for Ice Sheet Measurements* NASA Cryospheric Sciences Program grant # NAG5-11371, 10/01/2001 to 9/31/2006. Award of $436k over 5 years.

E. A. Butcher (PI) and E. **Bueler** (Co-PI), *Symbolic Stability and Bifurcation Analysis of Time-Periodic Differential-Delay Equations: Applications to High-Speed Machining Models*, NSF Civil and Mechanical Systems Directorate for Engineering # 0114500, 9/15/2001 to 8/31/2004. Award of $205k over 3 years. Also $5,014 supplemental for one REU student.

Supervisor of

- Dr. Andreas Aschwanden, ARSC and GI Postdoctoral Fellow, 2009–
- Constantine Khroulev, GI Research Professional, 2009–

Advisor of Graduate and Undergraduate Research

ms9. William Mitchell, M.S. Mathematics, Thesis: *Exact and numerical solutions for Stokes flow in glaciers*, UAF, August 2012.
ms8. Daniella DellaGiustina (co-advisee with Martin Truffer, Physics), M.S. Computational Physics, Thesis: *Regional modeling of Greenland's outlet glaciers with the Parallel Ice Sheet Model*, UAF, December 2011.

reu3. Benjamin Sperisen, ARSC Intern, Subject: Numerical analysis of ice flow, and visualization, Summer 2008.
reu2. Nathan Shemonski, ARSC Intern, Subject: Modeling the Greenland ice sheet, Summer 2007.
ms7. Jacob Stroh, M.S. Mathematics, Thesis: *Non-normality in scalar delay differential equations*, UAF, December 2006.
ms6. Jed A. Kallen-Brown, M.S. Mathematics, Project: *Multi-modal ice sheet dynamics: theory and implementation*, UAF, August 2006.
ms5. Timothy Carlson, M.S. Mathematics, Thesis: *Magnus' expansion as an approximation tool for ODEs*, UAF, May 2005.
reu1. Benjamin White, NSF REU, Subject: Delay differential equations, Summer 2004.
ms4. Latrice N. Bowman, M.S. Mathematics, Project: *Stability and accuracy of numerical finite difference methods applied to two dimensional isothermal ice flow*, UAF, November 2002.
ms3. Viktoria A. Averina, M.S. Mathematics, Thesis: *Symbolic stability of delay differential equations*, UAF, August 2002.
ms2. Mikhail Korotiaev, M.S. Mathematics, Thesis: *Critical Points of the heat kernel on a compact semisimple Lie group*, UAF, August 2002.
ms1. Liane Hansen, M.S. Mathematics, Project: *Numerical solution of a weighted Hodge Laplacian*, UAF DMS, May 1999.

Courses Taught

Undergraduate.

Math 200 Calculus I (F99, F01, S06, S08, F08, S13; also S92, F93, S94 at Cornell)
Math 201 Calculus II (S99, S01, F03; also F92 at Cornell)
Math 202 Calculus III (F98, F02)
Math 215 Introduction to Mathematical Proofs (S02, cotaught with Faudree)
Math 302 Differential Equations (S00, F00, S09)
Math 310 Numerical Analysis (F98, F99, F00, F02, F04, F09, F10, F11, F12)
Math 314 Linear Algebra (S07)
Math 412 Differential Geometry (S99, S03)
Math 421 Applied Analysis (F01, F04, F07, F11)
Math 422 Introduction to Complex Analysis (S08)
Math 490 Senior Seminar (S02, cotaught with Faudree)

Graduate.

Math 611/612 Mathematical Physics I (F05) & II (S06)
Math 615 Applied Numerical Analysis (S00, S02, S05, S07, S10, S12)
Math 641 Real Analysis I (F00, F01)
Math 692 Graduate Seminars in: random walks (S01), differential forms (F01, cotaught with Wiens), iterative methods in linear algebra (F03), finite elements (F04, cotaught with Maxwell)
Math 665 Numerical Linear Algebra (F03, S09, S11, S13)
Math 697 Individual Study in Functional Analysis (F02)

Professional Activities

- Lecturer on *Numerical modelling of ice sheets and ice shelves*, 2009, 2010, & 2012 Summer Schools on Ice Sheets and Glaciers in the Climate System, Karthaus, Italy
- Lecturer on *Numerical modelling of ice sheets and glaciers*, 2010 & 2012 International Summer School in Glaciology, McCarthy, Alaska.
- Invited speaker, European PISM (Parallel Ice Sheet Model) Workshop, May 2012, Max Planck Institute for Meteorology. This workshop organized by MPI-M is to bring together users of the PISM model from our group.
- Contributor to the *Sea-level Response to Ice Sheet Evolution (SeaRISE)* assessment process. A NASA-funded, community-organized international effort to estimate the upper bound of ice sheet contributions to sea level in the next 100–200 years using ice flow models and climate projections, especially for the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2013.
- Member of Arctic Region Supercomputing Center technical advisory panel (2010).
- Workshop on *Building a Next-Generation Community Ice Sheet Model* (co-organizer), Los Alamos, New Mexico, August 2008.
- Minisymposium on ice flow, SIAM Conference on Mathematical and Computational Issues in the Geosciences, Santa Fe, New Mexico, March 2007.

Member:

- Society for Industrial and Applied Mathematics (SIAM)
- International Glaciological Society (IGS)

Refereeing and reviewing:

- NASA review panel (2012), NSF proposals (2001,2006,2009), Netherlands NSF proposal (2007), U.K. NERC proposal (2010),
- Articles for *The Cryosphere*, *Eur. J. Appl. Math.*, *J. Fluid Mech.*, *J. Glaciol.*, *J. Geophys. Res.*, *I. J. M. M. S.*, *Math. Models Methods Appl. Sci.*, *J. Dyn. Sys. Meas. Control*, *Nonlinear Dynamics*, and *Physica D*.
- 14 reviews for *Mathematical Reviews* from 1998 to 2005
- Numerical analysis texts for Addison-Wesley (2000, 2001).