ED BUELER

Associate Professor of Mathematics (Applied)
Department of Mathematics and Statistics
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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.

Submitted

E. **Bueler** and W. van Pelt, 2014. *Mass-conserving subglacial hydrology in the Parallel Ice Sheet Model*, Geoscientific Model Development Discussions 7 (4), 4705–4775, doi:10.5194/gmdd-7-4705-2014.

Publications (peer-reviewed)

P24. E. **Bueler**, 2014. *An exact solution for a steady, flow-line marine ice sheet*, J. Glaciol. 60 (224), 1117–1125.
P23. E. **Bueler**, 2014. *Correspondence: Extending the lumped subglacial-englacial hydrology model of Bartholomaus and others (2011)*, J. Glaciol. 60 (222), 80–810.
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) 118 (2), 1025–1044.

[1] CV date: October 31, 2014

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), 118 (2), 1002–1024.

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*, J. Glaciol. 58 (209), 441–457.

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*, J. Glaciol. 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)*, J. Glaciol. 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*, J. Geophys. Res. (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 J. Num. 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*, J. Glaciol. 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*, Ann. Glaciol. 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*, J. Glaciol. 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): See `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, A. Aschwanden, and T. Albrecht. It is co-developed with the Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany, though all of the user support and documentation, and most of the code, is through my group at UAF.

Since 2007 there have been more than 40 peer-reviewed journal articles either describing applications of PISM, or about PISM design, including these listed above: **P6**, **P7**, **P12**, **P13**, **P15**, **P16**, **P18**, **P21**, **P22**, and **S25**. For the others, on which I am not a co-author, see

`www.pism-docs.org/wiki/doku.php?id=publications`

The UAF PISM group has active collaboration with researchers at the following institutions which use PISM, among others:

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

PISM is fully-parallelized using high performance computing tools PETSc and MPI and runs on thousands of processor cores on supercomputers. There are PDF *User's Manual*, *Climate Forcing Manual*, and *Installation Manual*, 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`

Publications **P8**, **P9**, and **P10** document or apply this software.

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 grant #NNX13AM16G, June 2013–June 2017. Award of $700k 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, October 2001–September 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, September 2001–August 2004. Award of $205k over 3 years, plus $5,014 supplemental for one REU student.

Supervisor of

- Dr. Andreas Aschwanden, ARSC and GI Postdoctoral Fellow, 2009–2013.
- Constantine Khroulev, GI Research Professional, 2009–present

Major advisor of Graduate and Undergraduate Research

Listed in reverse chronological order:

- Lyman Gillispie, M.S. Mathematics, Thesis: *A temperature-only formulation for ice sheets*, UAF, May 2014.
- Jeremiah Harrington, Honors Thesis in Mathematics: *Fourier techniques for sound visualization*, May 2013.
- William Mitchell, M.S. Mathematics, Thesis: *Exact and numerical solutions for Stokes flow in glaciers*, UAF, August 2012.
- 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.
- Benjamin Sperisen, ARSC undergraduate Intern, Subject: Numerical analysis of ice flow, and visualization, Summer 2008.
- Nathan Shemonski, ARSC undergraduate Intern, Subject: Modeling the Greenland ice sheet, Summer 2007.
- Jacob Stroh, M.S. Mathematics, Thesis: *Non-normality in scalar delay differential equations*, UAF, December 2006.
- Jed A. Kallen-Brown, M.S. Mathematics, Project: *Multi-modal ice sheet dynamics: theory and implementation*, UAF, August 2006.
- Timothy Carlson, M.S. Mathematics, Thesis: *Magnus' expansion as an approximation tool for ODEs*, UAF, May 2005.
- Benjamin White, NSF REU, Subject: Delay differential equations, Summer 2004.
- 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.
- Viktoria A. Averina, M.S. Mathematics, Thesis: *Symbolic stability of delay differential equations*, UAF, August 2002.
- Mikhail Korotiaev, M.S. Mathematics, Thesis: *Critical Points of the heat kernel on a compact semisimple Lie group*, UAF, August 2002.
- Liane Hansen, M.S. Mathematics, Project: *Numerical solution of a weighted Hodge Laplacian*, UAF DMS, May 1999.

Courses Taught at UAF

Undergraduate.

Math 200 Calculus I (F99, F01, S06, S08, F08, S13, F13; 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 401 Introduction to Real Analysis (F13)

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 Numerical Analysis of Differential Equations (S00, S02, S05, S07, S10, S12, S14)
Math 641 Real Analysis (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 (new course creation; taught 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, & 2014, Summer School on Ice Sheets and Glaciers in the Climate System, Karthaus, Italy
- Lecturer on *Numerical modelling of ice sheets and glaciers*, 2010, 2012, & 2014, International Summer School in Glaciology, McCarthy, Alaska.
- Invited speaker, European PISM (Parallel Ice Sheet Model) Workshop, May 2012, Max Planck Institute for Meteorology. Organized by MPI-M for PISM users.
- Contributor to the *Sea-level Response to Ice Sheet Evolution (SeaRISE)* assessment process, a NASA-funded international community effort to estimate an upper bound of ice sheet contributions to sea level in the next 100–200 years using ice flow models and climate projections, esp. for the IPCC AR5 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)
- American Geophysical Union (AGU)

Refereeing and reviewing:

- Reviews of articles for more than a dozen journals in applied mathematics, numerical analysis, geosciences, and glaciology. About five per year.
- DOE review panel (2011, 2014), NASA review panel (2012), NSF proposals (2001,2006,2009), Netherlands NSF proposal (2007), U.K. NERC proposal (2010),
- 14 reviews for *Mathematical Reviews* from 1998 to 2005
- Numerical analysis texts for Addison-Wesley (2000, 2001).