

# Anders Damsgaard

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## EDUCATION

- 2013–15 **Aarhus University**  
Department of Geoscience  
Ph.D.: “*Numerical modeling of subglacial sediment deformation*”  
*Supervisors*: David L. Egholm and Jan A. Piotrowski  
Thesis download: <https://adamsgaard.dk/ad-thesis.pdf>
- 2010–13 **Aarhus University**  
Department of Geoscience  
M.Sc. equivalent: Subglacial geology and sedimentology  
*Supervisors*: David L. Egholm and Jan A. Piotrowski
- 2006–10 **Aarhus University**  
Department of Geoscience  
B.Sc.: Quaternary Geology  
*Supervisors*: Christian Kronborg and Niels T. Knudsen

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## PROFESSIONAL EXPERIENCE

- 2018–Present **Danish Environmental Protection Agency**  
*Academic Technician*  
Ministry of Environment and Food in Denmark
- Automated quality control of geological, hydrological, and geochemical data
  - Design of databases related to groundwater mapping
  - Development of geospatial tools using QGIS, PostGIS, and PostgreSQL
- 2017–2018 **Princeton University**  
*Postdoctoral Research Associate*  
Program in Atmospheric and Oceanic Sciences  
Andlinger Center for Energy and the Environment  
Geophysical Fluid Dynamics Laboratory (GFDL)  
National Oceanographic and Atmosphere Administration (NOAA)
- Design of Lagrangian methods for simulating sea-ice dynamics
  - Analysis of sea-ice mechanics
  - Coupling of Lagrangian methods to global climate models
- Supervisors*: Alistair Adcroft and Olga Sergienko
- 2016–17 **Scripps Institution of Oceanography**  
*Green’s Foundation Postdoctoral Scholar*

Institute of Geophysics and Planetary Physics  
University of California, San Diego

- Subglacial hydrology modeling
- Sediment mechanics under the West Antarctic Ice Sheet
- Rate and state friction in discrete-element models

*Supervisor:* Helen A. Fricker

2015

**Aarhus University**

*Research assistant*

Department of Geoscience

- Markov-Chain Monte Carlo inversion of cosmogenic nuclide ages
- Constructed web front and backend for MATLAB inversion tools

*Supervisor:* Mads F. Knudsen

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**AWARDS, GRANTS, AND SCHOLARSHIPS**

- 2016 Aarhus University Research Foundation:  
Award for outstanding Ph.D. research in Science and Technology.
- 2016 XSEDE Startup Allocation, Principal Investigator: “Grain and fluid dynamics: Governors of glacier flow and earthquake initiation”, 48,000 CPU hours on GPU clusters Stampede, Comet and Bridges.
- 2016 NVIDIA Corporation, hardware grant (Tesla K40).
- 2016 Community Surface Dynamics Modeling System (CSDMS) Student Modeler Award 2016, University of Colorado Boulder, USA, for innovative model development in the field of earth-surface dynamics.
- 2015 Cecil H. and Ida M. Green Foundation for Earth Sciences scholarship, 50% of salary for two years.
- 2015 Department of Geoscience, Aarhus University, Annual Geoscience Day, best faculty or student presentation.

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**PUBLICATIONS**

- [9] **Damsgaard, A.**, O. Sergienko, and A. Adcroft “Ice-floe mechanics and pressure ridging in sea ice”. In preparation.
- [8] **Damsgaard, A.**, A. Adcroft, and O. Sergienko 2018 “Application of discrete-element methods to approximate sea-ice dynamics”. *Journal of Advances in Modeling Earth Systems*, vol. 10, 2228–2244. <https://doi.org/10.1029/2018MS001299>
- [7] Bateman, M. D., D. A. Swift, J. A. Piotrowski, E. J. Rhodes, **A. Damsgaard** 2018 “Can glacial shearing of sediment reset the signal used for luminescence dating?”. *Geomorphology*, vol. 306, 90–101. <https://doi.org/10.1016/j.geomorph.2018.01.017>

- [6] **Damsgaard, A.**, J. Suckale, J. A. Piotrowski, M. Houssais, M. R. Siegfried, and H. A. Fricker 2017 “Sediment behavior controls equilibrium width of subglacial channels”. *Journal of Glaciology*, vol. 63, 1034–1048. <https://doi.org/10.1017/jog.2017.71>
- [5] **Damsgaard, A.**, A. Cabrales-Vargas, J. Suckale, and L. Goren 2017 “The coupled dynamics of meltwater percolation and granular deformation in the sediment layer underlying parts of the big ice sheets”. *Poromechanics VI*. <https://doi.org/10.1061/9780784480779.024>
- [4] **Damsgaard, A.**, D. L. Egholm, L. H. Beem, N. K. Larsen, S. Tulaczyk, J. A. Piotrowski, and M. R. Siegfried 2016 “Ice flow dynamics forced by water pressure variations in subglacial granular beds”. *Geophysical Research Letters*, vol. 43, 12 165–12 173. <https://doi.org/10.1002/2016GL071579>
- [3] **Damsgaard, A.**, D. L. Egholm, J. A. Piotrowski, S. Tulaczyk, N. K. Larsen, and C. F. Brædstrup 2015 “A new methodology to simulate subglacial deformation of water-saturated granular material”. *The Cryosphere*, vol. 9, 2183–2200. <https://doi.org/10.5194/tc-9-2183-2015>
- [2] Brædstrup, C. F., **A. Damsgaard**, and D. L. Egholm 2014 “Ice-sheet modelling accelerated by graphics cards”. *Computers & Geosciences*, vol. 72, 210–220. <https://doi.org/10.1016/j.cageo.2014.07.019>
- [1] **Damsgaard, A.**, D. L. Egholm, J. A. Piotrowski, S. Tulaczyk, N. K. Larsen, and K. Tylmann 2013 “Discrete element modeling of subglacial sediment deformation”. *Journal of Geophysical Research: Earth Surface*, vol. 118, 2230–2242. <https://doi.org/10.1002/2013JF002830>

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## PRESENTATIONS

### Invited talks

- [9] J. Suckale, C. W. Elsworth, E. Mantelli, I. Kasmalkar, **A. Damsgaard**, J. D. Platt, T. Perol, J. R. Rice, L. Goren “Process-based models for ice-stream shear margins”. American Geophysical Union Fall Meeting 2018, Washington D.C., USA.
- [8] J. Suckale, C. W. Elsworth, E. Mantelli, I. Kasmalkar, **A. Damsgaard**, J. D. Platt, T. Perol, J. R. Rice, L. Goren “The surface as a window into the subsurface: Lessons from Antarctica”. American Geophysical Union Fall Meeting 2018, Washington D.C., USA.
- [7] **A. Damsgaard**, J. Suckale, J. A. Piotrowski, M. Houssais, M. R. Siegfried, and H. A. Fricker “Subglacial channelized drainage on soft beds and implications for grounding-line dynamics”. Geological Society of America Annual Meeting 2017, Seattle, WA, USA.
- [6] **A. Damsgaard**, D. L. Egholm, J. Suckale, J. A. Piotrowski, M. Houssais, M. R. Siegfried, and H. A. Fricker “Grain-scale numerical modeling of granular mechanics and fluid dynamics”. Week’s lecturer at University of Wisconsin Madison, Department of Geoscience, November 2017.
- [5] **A. Damsgaard**, D. L. Egholm, S. Tulaczyk, J. A. Piotrowski, N. K. Larsen, M. R. Siegfried, L. H. Beem, and J. Suckale “Subglacial sediment mechanics investigated by computer simulation of granular material”. American Geophysical Union Fall Meeting 2016, San Francisco, CA, USA.
- [4] J. Suckale, C. W. Elsworth, **A. Damsgaard**, L. Goren, A. Cabrales, D. Li, I. Kasmalkar, and S. Maldonado “Taking advantage of the predictive potential of process-based models for

ice exploration”. American Geophysical Union Fall Meeting 2016, San Francisco, CA, USA.

- [3] **A. Damsgaard**, D. L. Egholm, S. Tulaczyk, N. K. Larsen, J. A. Piotrowski, M. R. Siegfried, L. H. Beem, J. Suckale, and L. Goren “Grain-scale numerical modeling of granular mechanics and fluid dynamics”. Stanford University, Department of Geoscience, July 2016.
- [2] **A. Damsgaard**, D. L. Egholm, L. H. Beem, S. Tulaczyk, N. K. Larsen, J. A. Piotrowski, and M. R. Siegfried “Grain-scale numerical modeling of granular mechanics and fluid dynamics and application in a glacial context”. Keynote speaker at Community Surface Dynamics Modeling System (CSDMS) Annual Meeting, March 2016, Boulder, CO, USA.
- [1] C. F. Brødstrup, D. L. Egholm, S. V. Ugelvig, **A. Damsgaard**, and J. L. Andersen “Feedbacks between subglacial dynamics and long-term glacial landscape evolution”. American Geophysical Union Fall Meeting 2013, San Francisco, CA, USA.

### Oral presentations

- [12] **A. Damsgaard**, O. Sergienko, and A. Adcroft “Lagrangian methods for modeling compressive failure in sea ice across scales”. American Geophysical Union Fall Meeting 2018, Washington D.C., USA.
- [11] J. Suckale, C. W. Elsworth, E. Mantelli, I. Kasmalkar, **A. Damsgaard**, J. D. Platt, T. Perol, J. R. Rice, L. Goren “Advancing process-based models of shear margins to enable model-data integration”. West Antarctic Ice Sheet Workshop 2018, NY, USA.
- [10] J. A. Piotrowski, M. B. Holdensen, W. Narloch, S. Carr, **A. Damsgaard**, N. K. Larsen “Subglacial till deformation constrained by laboratory experiments”. European Geosciences Union, General Assembly 2018, Vienna, Austria, EGU2018–8662.
- [9] J. A. Piotrowski, M. Bering Holdensen, W. Narloch, **A. Damsgaard**, N. K. Larsen “Subglacial till deformation: Lessons from laboratory experiments”. Nordic Geological Winter Meeting 2018, Copenhagen, Denmark.
- [8] **A. Damsgaard**, A. Adcroft, O. Sergienko, and A. Stern “Discrete-element simulation of sea-ice mechanics: Contact mechanics and granular jamming”. American Geophysical Union Fall Meeting 2017, New Orleans, LA, USA.
- [7] I. Kasmalkar, **A. Damsgaard**, A. Cabrales-Vargas, J. Suckale, and L. Goren “Grain-scale investigation of grain and melt-water interaction and implications for the dynamics of ice flow over soft sediments”. 6th Biot Conference on Poromechanics 2017, Paris, France.
- [6] **A. Damsgaard**, D. L. Egholm, L. H. Beem, S. Tulaczyk, N. K. Larsen, J. A. Piotrowski, and M. R. Siegfried “Creep and stick-slip in subglacial granular beds forced by variations in water pressure”. West Antarctic Ice Sheet Workshop 2016, VA, USA.
- [5] **A. Damsgaard**, D. L. Egholm, L. H. Beem, S. Tulaczyk, N. K. Larsen, J. A. Piotrowski, and M. R. Siegfried “Creep and stick-slip in subglacial granular beds forced by ocean tides”. International Glaciological Society, International Symposium on Interactions of Ice Sheets and Glaciers with the Ocean, 2016, La Jolla, CA, USA.
- [4] **A. Damsgaard**, D. L. Egholm, J. A. Piotrowski, S. Tulaczyk, and N. K. Larsen “Oscillations in till strength due to particle-fluid feedbacks”. International Union for Quaternary Research Congress, 2015, Nagoya, Japan.
- [3] J. A. Piotrowski, K. Tylmann, W. Narloch, W. Wysota, **A. Damsgaard**, D. L. Egholm, N. K. Larsen, and J. Lesemann. “A soft-bed system under the Scandinavian Ice Sheet: Mosaic

of stable and deforming spots”. Abstract from 31st Nordic Geological Winter Meeting 2014, Lund, Sweden.

- [2] **A. Damsgaard**, D. L. Egholm, J. A. Piotrowski, S. Tulaczyk, and N. K. Larsen “Discrete element modeling of subglacial sediment deformation”. American Geophysical Union Fall Meeting 2013, San Francisco, CA, USA.
- [1] J. A. Piotrowski, K. Tylmann, W. Narloch, W. Wysota, **A. Damsgaard**, D. L. Egholm, N. K. Larsen, and J. Lesemann “Subglacial mosaic of stable and deforming spots under the Scandinavian Ice Sheet: field, laboratory and numerical data”. Canadian Quaternary Association biannual meeting, August 2013, Edmonton, Canada.

### Poster presentations

- [8] D. Li, J. Suckale, A. Cabrales, and **A. Damsgaard** “Till dynamics underneath ice streams with a nonlocal dense granular flow model”. American Geophysical Union Fall Meeting 2016, San Francisco, CA, USA.
- [7] A. Cabrales-Vargas, J. Suckale, **A. Damsgaard**, and L. Goren “Spatially variable till deformation and water transport in ice-stream shear margins from numerical simulations”. American Geophysical Union Fall Meeting 2016, San Francisco, CA, USA.
- [6] **A. Damsgaard**, D. L. Egholm, J. A. Piotrowski, S. Tulaczyk, N. K. Larsen, and C. F. Brædstrup “Numerical modeling of particle-fluid mixtures in a subglacial setting”. American Geophysical Union Fall Meeting 2014, San Francisco, CA, USA.
- [5] **A. Damsgaard**, D. L. Egholm, J. A. Piotrowski, S. Tulaczyk, and N. K. Larsen “Numerical modelling of granular subglacial deformation using the discrete element method”. European Geosciences Union, General Assembly 2013, Vienna, Austria, EGU2013–4026.
- [4] **A. D. Christensen**, D. L. Egholm, J. A. Piotrowski, and S. Tulaczyk “Discrete element modelling of subglacial sediment deformation”. European Geosciences Union, General Assembly 2012, Vienna, Austria, EGU2012–2931.
- [3] O. R. Clausen, D. L. Egholm, R. Wesenberg, and **A. D. Christensen** (presenting author) “Salt movements and faulting of the overburden — can numerical modeling predict the fault patterns above salt structures?” European Geosciences Union, General Assembly 2012, Vienna, Austria, EGU2012–1615.
- [2] **A. D. Christensen**, D. L. Egholm, and J. A. Piotrowski “Numerical modelling of sediment deformation by glacial stress”. International Union for Quaternary Research Congress 2011, Bern, Switzerland.
- [1] **A. D. Christensen**, D. L. Egholm, and J. A. Piotrowski “Numerical modelling of subglacial sediment deformation”. European Geosciences Union, General Assembly 2011, Vienna, Austria, EGU2011–7829.

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### PROFESSIONAL AFFILIATIONS

- Member, American Geophysical Union (2013–present)
- Member, Geological Society of America (2017–present)
- Member, International Glaciological Society (2015–present)
- Member, European Geosciences Union (2011–2013)
- Member, CICE Consortium (2017–present)

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### SELECT ACTIVITIES IN PROGRAMMING AND HIGH-PERFORMANCE COMPUTING

- Proficient programmer in C, C++, OpenMP, MPI, Python, CUDA C, Octave/MATLAB, Julia, HTML/CSS/Javascript/PHP/MySQL, bash/sed/awk,  $\LaTeX$ , and POSIX operating system environments.
- Creator of **sphere**, a three-dimensional discrete element method algorithm with optional fluid coupling. Written in CUDA C, C++, and Python for GPU-based simulation of grain and fluid dynamics. Uses Doxygen software reference documentation and unit testing. Free and open-source licensed. <https://github.com/anders-dc/sphere>
- Creator of **Granular.jl**, a two-dimensional discrete element method algorithm for sea-ice simulation with coupling to NOAA ocean and atmosphere models. Written in Julia. Uses Travis-CI automated testing and is fully documented at <https://anders-dc.github.io/Granular.jl/latest/>. Free and open-source licensed. <https://github.com/anders-dc/Granular.jl>
- Creator of **cosmo.au.dk**, a webpage for inversion of cosmogenic nuclide concentrations. Consists of a responsive front end using HTML and Angular and JQuery Javascript libraries, backed by PHP for queuing and MATLAB for numerical inversion. The service is running on a Ubuntu GNU/Linux virtual machine. <https://cosmo.au.dk>
- Creator of **lbm-d3q19**, a three-dimensional lattice-Boltzmann solver for incompressible Navier-Stokes fluid flow. Written in C with OpenMP parallelization. Free and open-source licensed. <https://github.com/anders-dc/lbm-d3q19>
- Designed, constructed, and maintained a Dell/NVIDIA 192 CPU-core GPU cluster, Aarhus University. Running Debian GNU/Linux and Torque/MAUI resource management and scheduling.
- Technical reviewer for “Getting Started with Tmux”, Packt Publishing 2014. Tmux is a software application for terminal multiplexing, useful for dealing with multiple programs from a command-line interface.
- Contributor to **Icepack** and **CICE**, numerical codes for sea-ice column physics and dynamics. <https://github.com/CICE-Consortium/Icepack>  
<https://github.com/CICE-Consortium/CICE>

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### SERVICE TO THE FIELD

Reviewer for the following agencies and academic journals:

- National Science Foundation
- Nature Geoscience
- Journal of Glaciology
- Quaternary Science Reviews
- The Cryosphere
- Journal of Geophysical Research
- Ocean Modelling

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## TEACHING AND OUTREACH

- Taught a workshop on granular modeling using the discrete element method. University of Wisconsin Madison, Department of Geoscience, November 2017.
- Guest teacher in SIO 209 “Palaeoclimate seminar”, Scripps Institution of Oceanography. Gave class on subglacial friction and ice sheet stability. April 2016.
- Guest teacher in SIO 115 “Ice in the Climate System”, Scripps Institution of Oceanography. Gave class on glacier dynamics and subglacial mechanics and hydrology. March 2016.

### Mentoring

- 2017–2018: Indraneel Kasmalkar, Department of Geophysics, Stanford University. Graduate student with Jenny Suckale. Indraneel used my particle-fluid model to simulate processes beneath ice-stream margins.
- 2018: MonTre D. Hudson, Program in Atmospheric and Oceanic Sciences, Princeton University. MonTre was a summer-intern for the AOS diversity program, and used my sea-ice model to simulate rifting under ocean and wind forcings.

### Outreach

- Article (two full pages) in danish newspaper “Nordjyske Stifttidende” about my research on climate change and sediment mechanics. September 2015.
- Presentations about climate change and glaciology to high-school teachers. Department of Geoscience, Aarhus University. October 2013.
- Arranged introductory talks about the research activities of faculty members. Aarhus University, 2012–2013.
- “The Rolling University” (Danish: “Det Rullende Universitet”): Held a series of lectures at local high schools about climate change. Fall 2011.
- “Nature in the tent” (Danish: “Natur i teltet”): Public outreach in the city center in Aarhus, Denmark. Summer 2009.

### Teaching assistance at Aarhus University

- Theoretical Geophysics (exercises)
- Geophysical Methods (exercises and field excursions)
- Sedimentology (exercises)
- Numerical Modeling (exercises)
- Sedimentary Processes and Environments (classes, exercises, and field excursions)
- Introductory Petrology (classes and exercises)
- Basin analysis and modeling (classes and exercises)
- Geographical Information Systems (exercises)
- Quaternary Sediments (parts I and II, classes and field excursion)

- Geomodeling (exercises)
- Palaeontology and stratigraphy (exercises)
- Hydrology, soil processes, and dynamic geomorphology (classes, exercises, and field excursion)