

## David A. Lilien

Research Associate

Centre for Earth Observation Science, University of Manitoba

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### Academic Appointments

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Assistant professor	Starting 2024
Department of Earth and Atmospheric Science, Indiana University	
Research associate	2021 – present
Centre for Earth Observation Science, University of Manitoba	
Postdoctoral researcher	2019 – 2021
Physics of Ice, Climate, and Earth, Niels Bohr Institute, University of Copenhagen	

### Education

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PhD in Earth and Space Sciences	2019
University of Washington, Seattle, WA	
BS in Physics and Mathematics	2013
Yale University, New Haven, CT	

### Research Interests

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I study the dynamics of ice streams and outlet glaciers in Antarctica and Greenland. My technical expertise is in ice-flow modeling and ice-penetrating radar methodology. I am most interested in new ways to use radar to improve numerical models of ice streams and outlet glaciers.

### Fellowships

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NASA Earth and Space Sciences Fellow	2015 – 2018
3 years stipend, portion of tuition	
University of Washington Program on Climate Change Fellow	2013
9 months stipend	

### Publications

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Dmitrenko, IA, SA Kirillov, B Rudels, NX Geilfus, J Ehn, DG Babb, **DA Lilien**, and D Dahl-Jensen (2023). Modification of Pacific water in the northern Canadian Arctic, *Frontiers in Marine Science*, 10. (doi:10.3389/fmars.2023.1181800)

Gerber, TA, **DA Lilien**, NM Rathmann, S Franke, TJ Young, F Valero-Delgado, MR Ershadi, R Drews, O Zeising, A Humbert, N Stoll, I Weikusat, A Grinsted, CS Hvidberg, D Jansen, H Miller, V Helm, D Steinhage, C O'Neill, J Paden, SP Gogineni, D Dahl-Jensen, and O Eisen (2023). Crystal orientation fabric anisotropy causes directional

- hardening of the Northeast Greenland Ice Stream, *Nature Communications*, **14**, 2653. (doi:10.1038/s41467-023-38139-8)
- Rathmann, NM, A Grinsted, K Mosegaard, **DA Lilien**, J Westhoff, CS Hvidberg, DJ Prior, F Lutz, RE Thomas, and D Dahl-Jensen (2022). Elastic wave propagation in anisotropic polycrystals: Inferring physical properties of glacier ice. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, **478**(2268), 20220574 (doi:10.1098/rspa.2022.0574).
- Grinsted, A, CS Hvidberg, **DA Lilien**, NM Rathmann, NB Karlsson, TA Gerber, HA Kjær, P Vallelonga, and D Dahl-Jensen (2022). Accelerating ice flow at the onset of the Northeast Greenland Ice Stream. *Nature Communications*. **13**, 5589 (doi:10.1038/s41467-022-32999-2).
- Rathmann, NM, and **DA Lilien** (2022). On the nonlinear viscosity of the orthotropic bulk rheology. *Journal of Glaciology*, **68**(272), 1243-1248 (doi:10.1017/jog.2022.33).
- Rathmann, NM, **DA Lilien**, A Grinsted, TA Gerber, TJ Young, and D Dahl-Jensen (2022). On the Limitations of Using Polarimetric Radar Sounding to Infer the Crystal Orientation Fabric of Ice Masses. *Geophysical Research Letters*. **49**, e2021GL096244 (doi:10.1029/2021GL096244).
- Lilien, DA**, NM Rathmann, CS Hvidberg, and D Dahl-Jensen (2021). Modeling ice-crystal fabric as a proxy for ice-stream stability. *Journal of Geophysical Research: Earth Surface*. **126**, e2021JF006306 (doi:10.1029/2021JF006306).
- Rathmann, NM, and **DA Lilien** (2021). Inferred basal friction and mass flux affected by crystal-orientation fabric. *Journal of Glaciology*. **68**(268), 236-252 (doi:10.1017/jog.2021.88).
- Lilien, DA**, D Steinhage, D Taylor, F Parrenin, C Ritz, R Mulvaney, C Martín, JB Yan, C O'Neill, M Frezzotti, H Miller, P Gogineni, D Dahl-Jensen, and O Eisen (2021). New radar constraints support presence of ice older than 1.5 Myr at Little Dome C. *The Cryosphere*. **15**(4), 1881–1888 (doi:10.5194/tc-15-1881-2021).
- Rathmann, NM, CS Hvidberg, A Grindsted, **DA Lilien**, and D Dahl-Jensen (2021). Effect of a nonlinear grain rheology on polycrystalline directional enhancement factors. *Journal of Glaciology*. **67**(263), 569-575 (doi:10.1017/jog.2020.117).
- Lilien, DA**, B Hills, J Driscoll, R Jacobel, and K Christianson (2020). ImpDAR: An open-source impulse radar processor. *Annals of Glaciology*. **81**(61), 114-123 (doi:10.1017/aog.2020.44).
- Fudge, TJ, **DA Lilien**, M Koutnik, H Conway, CM Stevens, ED Waddington, EJ Steig, AJ Schauer, and N Holschuh (2020). Advection and non-climate impacts on the South Pole Ice Core. *Climate of the Past*. **8**, 819-832 (doi:10.5194/cp-16-819-2020).

- Lilien, DA**, I Joughin, B Smith, and N Gourmelen (2019). Melt at grounding line controls observed and future retreat of Smith, Pope, and Kohler Glaciers, *The Cryosphere*. **13**, 2817–2834 (doi:10.5194/tc-13-2817-2019).
- Holschuh, N, **DA Lilien**, and K Christianson (2019). Thermal Weakening, Convergent Flow, and Vertical Heat Transport in the Northeast Greenland Ice Stream Shear Margins. *Geophysical Research Letters*. **46**(14), (doi:10.1029/2019GL083436).
- Lilien, DA**, TJ Fudge, MR Koutnik, H Conway, EC Osterberg, DG Ferris, ED Waddington, and CM Stevens (2018). Holocene Ice-Flow Speedup in the Vicinity of the South Pole. *Geophysical Research Letters*. **45**(13), 6557–6565 (doi:10.1029/2018GL078253).
- Lilien, DA**, I Joughin, B Smith, and DE Shean (2018). Changes in flow of Crosson and Dotson ice shelves, West Antarctica, in response to elevated melt. *The Cryosphere*. **12**, 1415–1431 (doi:10.5194/tc-12-1415-2018).
- Poinar, K, I Joughin, **D Lilien**, L Brucker, L Kehrl, and S Nowicki, (2017). Drainage of Southeast Greenland firn aquifer water through crevasses to the bed. *Frontiers in Earth Science*, **5**(5), (doi:10.3389/feart.2017.00005).
- Wasik, BR, SF Liew, **DA Lilien**, A Dinwiddie, H Noh, H Cao, & A Monteiro (2014). Artificial selection for structural color on butterfly wings and comparison with natural evolution. *PNAS*, 1402770111 (doi:10.1073/pnas.1402770111).

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### Manuscripts accepted, submitted, and in preparation

- Lilien, DA**, NM Rathmann, CS Hvidberg, A Grinsted, MR Ershadi, R Drews, and D Dahl-Jensen. Simulating complex fabrics in a large-scale, anisotropic ice-flow model: application to Dome C, East Antarctica. In review at *Journal of Glaciology*.
- Chung, A, F Parrenin, D Steinhage, R Mulvaney, D Taylor, **DA Lilien**, C Ritz, M Cavitte, C Martin, C O'Neill, P Gogineni, H Miller, D Dahl-Jensen, and O Eisen. Stagnant ice and age modelling in the Dome C region, Antarctica. In press in *The Cryosphere*.
- Stevens, CM, **DA Lilien**, TJ Fudge, M Koutnik, H Conway, B Horlings, and ED Waddington. Deriving a firn compaction model for South Pole based on strain measurements. In revision for *Journal of Glaciology*.
- Voss, K, K Alley, **DA Lilien**, and D Dahl-Jensen. The Role of Terminus Conditions in the Ice-Flow Speed of the Upernavik Isstrøm. In revision for *Annals of Glaciology*.

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### Conference Papers

- Knerr, N, D Taylor, S Gogineni, **D Lilien**, D Steinhage, D Dahl-Jensen, H Miller, and O Eisen (2022). Processing and Analysis of Radar Data to Map Layers Near the Bed to Determine Optimum Ice Core Site. *IGARSS 2022 IEEE International Geoscience and Remote Sensing Symposium*, 4182–4184. (doi:10.1109/IGARSS46834.2022.9884035)
- SF Liew, **D Lilien**, H Noh, H Cao, BR Wasik, AJ Dinwiddie, and A Monteiro (2014). Artificial selection for structural color on butterfly wings and comparison to natural

evolution. *Conference on Lasers and Electro-Optics (CLEO) - Laser Science to Photonic Applications*. 1-2.

## Field Experience

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Müller Ice Cap, Nunavut, Canada	2023
Led planning and logistics for two week, five person team based on an ice cap in the Canadian Arctic, supported by the Polar Continental Shelf Program. Led radar survey in support of ice-core selection.	
EastGRIP, Greenland	2022
Worked on extensive radar survey using two new, state-of-the-art radars. Led radar operation and data processing, co-led survey design. Work included supervision of two PhD students while in the field.	
Little Dome C, Antarctica	2019
Part of a 3-person radar team surveying to select the location of the Beyond EPICA Oldest Ice core. Led data processing, assisted in data collection and survey design.	
South Pole, Antarctica	2016 – 2019
Three seasons on an NSF-sponsored project at South Pole Station and in the deep field. Led extensive high frequency radar survey. Co-led shallow-core and GPS survey. Assisted in drilling operations and firn-densification instrument installation.	
Mt. Baker and Mt. Rainier, WA	2015 – 2018
Assisted with various 1-2 day surveys using Lidar, ground-based interferometric radar, and GPS on Easton, Coleman, and Nisqually glaciers.	

## Service

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Reviewer for <i>The Cryosphere</i> , <i>Nature Geoscience</i> , <i>JGR: Earth Surface</i> , <i>Journal of Glaciology</i> , <i>Annals of Glaciology</i> , and for German polar airborne applications	
Participant, NASA DEBRIS mission design workshop	2022
Graduate student representative on first-year PhD exam committees	2017 – 2018
Graduate student representative on student awards committee	2018

## Teaching Experience

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### Mentor for graduate students

Kelsey Voss, UoM – MSc student, advising on glacier modeling	2021 – 2023
Niels Nyman, UCPH – PhD student, advising on radio echo sounding	2022 – present
Debanshu Banarjee, UoM – PhD student, advising on glacier modeling	2022 – present

**Mentor for undergraduates**

Ian Lee – remote sensing of Nivlisen Ice Shelf	2015
Joshua Driscoll – automatic layer picking for radar	2018 – 2019

**Teaching assistant**

UW ESS 451: <i>Principles of glaciology</i>	2015
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**Guest Lectures**

Ice-crystal fabric and glacier dynamics: modeling a property that controls and records ice flow. For U. Manitoba GEOG 3390 Introduction to Climate Change.	2023
Ice flow modeling. For U. Manitoba ENVR 3000 T05: Introduction to Numerical Modelling.	2023
Open source software in the geosciences: lessons from ImpDAR. for University of Washington summer interns in glaciology	2022
ImpDAR: an open-source radar processor for University of Maine graduate students	2022
Substitute lecturer for University of Washington ESS 431, 1 class	2018

**Presentations**

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- “Ice-crystal fabric: modeling and observing a property that controls ice-sheet flow.” *Indiana University Earth and Atmospheric Sciences*. March, 2023. Invited
- “Using ice-flow models and radar to understand ice-stream retreat.” *Washington State University School of the Environment*. February, 2023. Invited.
- “Simulating complex fabrics in a coupled, anisotropic ice-flow model: application to Dome C.” Poster. *AGU Fall Meeting*. December, 2022.
- “Ice-crystal fabric: inference from radar and why it matters.” *DEBRIS Workshop, NASA JPL*. September, 2022. Invited.
- “Modeling ice-crystal fabric as a proxy for ice-stream stability.” Poster. *AGU Fall meeting*. December, 2020.
- “Modeling ice-crystal fabric as a proxy for ice-stream stability.” *University of Tübingen/Alfred Wegner Institute structural geology seminar*. November, 2020. Invited.
- “Melt at grounding line controls observed and future retreat of Smith, Pope, and Kohler Glaciers.” *EGU General Assembly*. May 2020. Highlight talk.
- “Using ice-flow models to understand and contextualize modern ice-stream retreat.” *University of Wisconsin Weeks lecture*. February 2020. Invited.
- “Modeled temperature and basal shear stress of NEGIS and implications for surge mechanics of Storstrømmen.” *EastGRIP Steering Meeting*. November 2018.

“Elevated melt causes varied response of Crosson and Dotson Ice Shelves.” *West Antarctic Ice Sheet Workshop*. October 2017.

“Modeling the influence of melt and buttressing on the recent speedup of Smith Glacier.” *International Symposium on the Interaction of Glaciers and Ice Sheets with the Ocean*. July 2016.

“Quantifying Uncertainty in Inferred Viscosity and Basal Shear Stress Over Ice Streams.” Poster. *AGU Fall Meeting*. December 2015.

“Modeling ocean-forced changes in Smith Glacier, West Antarctica.” Poster. *AGU Fall Meeting*. December 2014.

## **Outreach**

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Organizer, glaciology display, Polar Science Weekend, Pacific Science Center 2015–2018

Volunteer, University of Washington Rockin’ Out 2013–2019

## **Computer Skills**

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Proficient: Python, Git, Bash, Elmer/Ice, Fortran, QGIS

Familiar: Matlab, C, Slurm, Torque

## **Professional Affiliations**

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International Glaciological Society

American Geophysical Union

European Geosciences Union