

## ALEX S. GARDNER

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Jet Propulsion Laboratory  
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### PROFESSIONAL EXPERIENCE

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Scientist, Sea Level And Ice, Earth Science Section  
Jet Propulsion Laboratory/California Institute of Technology (2014-present)

Assistant Professor, Graduate School of Geography  
Clark University (2012-2014)

Research Assistant Professor, George Perkins Marsh Institute  
Clark University (2012-2014)

NSERC Research Fellow, Department of Atmospheric, Oceanic and Space Sciences  
University of Michigan (2010-2012)

### EDUCATION

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Ph.D. (August 2010)

Department of Earth and Atmospheric Sciences, University of Alberta

Dissertation title: *Surface mass balance of Arctic glaciers: Climate influences and modelling approaches*

B. Eng., Great Distinction (May 2005)

Department of Civil Engineering, University of Saskatchewan

*Awarded the Civil Engineering Alumni Medal for graduating first in class.*

### AWARDS (SELECTED)

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2018	• JPL Lew Allen Award for Excellence	\$10,000
2017	• NASA Early Career Achievement Medal	Medal
2009	• NSERC Postdoctoral Fellowship	\$80,000
2008	• A. Stewart Memorial Graduate Prize (Awarded to top 25 University of Alberta PhD candidates)	\$5,000
2006	• NSERC Alexander Graham Bell Canada Graduate Scholarship D	\$105,000
	• Alberta Ingenuity Student Scholarship	\$110,000
2005	• NSERC Canada Graduate Scholarship M	\$21,000
	• Walter H Johns Graduate Fellowship	\$19,000
2004	• Civil Engineering Alumni Medal (Top Civil Engineering Graduate)	Medal

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- Wouters, B., **A. S. Gardner** and G. Moholdt (2019). Status of the global glaciers from GRACE (2002-2016). *Frontiers in Earth Science* 7: 75.
- Tapley, B., M. M. Warkins, F. Flechtner, C. Reigber, S. Bettadpur, M. Rodell, I. Sasgen, J. Famiglietti, F. Landerer, D. Chambers, J. Reager, **A. S. Gardner**, H. Save, imanshu, E. Ivins, S. Swenson, C. Boening, C. Dahle, D. Wiese, H. Dobslaw, M. Tamisiea and I. Velicogna (accepted). Contributions of GRACE to understanding climate change. *Nature Climate Change*.
- Khazendar, A., I. G. Fenty, D. Carroll, **A. S. Gardner**, C. M. Lee, I. Fukumori, O. Wang, H. Zhang, H. Seroussi, D. Moller, B. P. Y. Noël, M. R. van den Broeke, S. Dinardo and J. Willis (2019). Interruption of two decades of Jakobshavn Isbrae acceleration and thinning as regional ocean cools. *Nature Geoscience*.
- St. Pierre, K. A., V. L. St. Louis, I. Lehnherr, S. L. Schiff, D. C. G. Muir, A. J. Poulain, J. P. Smol, C. Talbot, M. Ma, D. L. Findlay, W. J. Findlay, S. E. Arnott and **A. S. Gardner** (2019). Contemporary limnology of the rapidly changing glacierized watershed of the world's largest High Arctic lake. *Scientific Reports* 9(1): 4447.
- St. Pierre, K. A., V. L. St. Louis, I. Lehnherr, **A. S. Gardner**, J. A. Serbu, C. A. Mortimer, D. C. G. Muir, J. A. Wiklund, D. Lemire, L. Szostek and C. Talbot (2019), Drivers of Mercury Cycling in the Rapidly Changing Glacierized Watershed of the High Arctic's Largest Lake by Volume (Lake Hazen, Nunavut, Canada), *Environmental Science & Technology*, 53(3), 1175-1185, doi:10.1021/acs.est.8b05926.
- Menounos, B., R. Hugonnet, D. Shean, **A. Gardner**, I. Howat, E. Berthier, B. Pelto, C. Tennant, J. Shea, M.-J. Noh, F. Brun and A. Dehecq (2019). Heterogeneous Changes in Western North American Glaciers Linked to Decadal Variability in Zonal Wind Strength. *Geophysical Research Letters* 46(1): 200-209.
- Dehecq, A.\***, N. Gourmelen, **A. S. Gardner**, F. Brun, D. Goldberg, P. W. Nienow, E. Berthier, C. Vincent, P. Wagon, and E. Trouvé (2018), Twenty-first century glacier slowdown driven by mass loss in High Mountain Asia, *Nature Geosci.*, doi:10.1038/s41561-018-0271-9.
- Smith, B. E., **A. S. Gardner**, A. Schneider, and M. Flanner (2018), Modeling biases in laser-altimetry measurements caused by scattering of green light in snow, *Remote Sensing of the Environment*, 215, 398-410, doi:https://doi.org/10.1016/j.rse.2018.06.012.
- Behrangi, A., **A. Gardner**, J. T. Reager, J. B. Fisher, D. Yang, G. J. Huffman, and R. F. Adler Using GRACE to estimate snowfall accumulation and assess gauge undercatch corrections in high latitudes, *Journal of Climate*, doi:10.1175/jcli-d-18-0163.1.
- WCRP Global Sea Level Budget Group (2018). Global sea-level budget 1993–present. *Earth System Science Data* 10(3): 1551-1590.
- Minchew, B. M., G. H. Gudmundsson, **A. S. Gardner**, F. S. Paolo, and H. A. Fricker (2018), Modeling the dynamic response of outlet glaciers to observed ice-shelf thinning in the Bellingshausen Sea Sector, West Antarctica, *Journal of Glaciology*, 1-10, doi:10.1017/jog.2018.24.
- Lehnherr, I., V. L. St. Louis, M. Sharp, **A. S. Gardner**, J. P. Smol, S. L. Schiff, D. C. G. Muir, C. A. Mortimer, N. Michelutti, C. Tarnocai, K. A. St. Pierre, C. A. Emmerton, J. A. Wiklund, G. Köck, S. F. Lamoureux and C. H. Talbot (2018), The world's largest High Arctic lake responds rapidly to climate warming, *Nature Communications*, 9(1), 1290, doi:10.1038/s41467-018-03685-z.

- Shepherd, A., E. Ivins, E. Rignot, B. Smith, M. van den Broeke, I. Velicogna, P. Whitehouse, K. Briggs, I. Joughin, G. Krinner, S. Nowicki, T. Payne, T. Scambos, N. Schlegel, G. A. C. Agosta, A. Ahlstrøm, G. Babonis, V. Barletta, A. Blazquez, J. Bonin, B. Csatho, R. Cullather, D. Felikson, X. Fettweis, R. Forsberg, H. Gallee, **A. S. Gardner**, L. Gilbert, A. Groh, B. Gunter, E. Hanna, C. Harig, V. Helm, A. Horvath, M. Horwath, S. Khan, K. K. Kjeldsen, H. Konrad, P. Langen, B. Lecavalier, B. Loomis, S. Luthcke, M. McMillan, D. Melini, S. Mernild, Y. Mohajerani, P. Moore, J. Mouginot, G. Moyano, A. Muir, T. Nagler, G. Nield, J. Nilsson, B. Noel, I. Ootosaka, M. E. Pattle, W. R. Peltier, N. Pie, R. Rietbroek, H. Rott, L. Sandberg-Sørensen, I. Sasgen, H. Save, B. Scheuchl, E. Schrama, L. Schröder, K.-W. Seo, S. Simonsen, T. Slater, G. Spada, T. Sutterley, M. Talpe, L. Tarasov, W. J. van de Berg, W. van der Wal, M. van Wessel, B. D. Vishwakarma, D. Wiese and B. Wouters (2018). "Mass balance of the Antarctic Ice Sheet from 1992 to 2017." *Nature* 558(7709): 219-222.
- Gardner, A. S.**, G. Moholdt, T. Scambos, M. Fahnestock, S. Ligtenberg, M. van den Broeke, and J. Nilsson (2018), Increased West Antarctic and unchanged East Antarctic ice discharge over the last 7 years, *The Cryosphere*, 12(2), 521-547, doi:10.5194/tc-12-521-2018.
- Walker, C. C. \***, and **A. S. Gardner** (2017), Rapid drawdown of Antarctica's Wordie Ice Shelf glaciers in response to ENSO/Southern Annular Mode-driven warming in the Southern Ocean, *Earth and Planetary Science Letters*, 476, 100-110, doi:https://doi.org/10.1016/j.epsl.2017.08.005.
- Cook, J. M., A. J. Hodson, **A. S. Gardner**, M. Flanner, A. J. Tedstone, C. Williamson, T. D. L. Irvine-Fynn, J. Nilsson, R. Bryant, and M. Tranter (2017), Quantifying bioalbedo: a new physically based model and discussion of empirical methods for characterising biological influence on ice and snow albedo, *The Cryosphere*, 11(6), 2611-2632, doi:10.5194/tc-11-2611-2017.
- Markus, T., T. Neumann, A. Martino, W. Abdalati, K. Brunt, B. Csatho, S. Farrell, H. Fricker, **A. Gardner**, D. Harding, M. Jasinski, R. Kwok, L. Magruder, D. Lubin, S. Luthcke, J. Morison, R. Nelson, A. Neuenschwander, S. Palm, S. Popescu, C. K. Shum, B. E. Schutz, B. Smith, Y. Yang and J. Zwally (2017), The Ice, Cloud, and land Elevation Satellite-2 (ICESat-2): Science requirements, concept, and implementation, *Remote Sensing of Environment*, 190, 260-273, doi:http://dx.doi.org/10.1016/j.rse.2016.12.029.
- Behrangi, A., **A. S. Gardner**, J. T. Reager, and J. B. Fisher (2017), Using GRACE to constrain precipitation amount over cold mountainous basins, *Geophysical Research Letters*, 44(1), 219-227, doi:10.1002/2016GL071832.
- Wada, Y., J. T. Reager, B. F. Chao, J. Wang, M.-H. Lo, C. Song, Y. Li, and **A. S. Gardner** (2017), Recent Changes in Land Water Storage and its Contribution to Sea Level Variations, *Surveys in Geophysics*, 38(1), 131-152, doi:10.1007/s10712-016-9399-6.
- Nilsson, J. \***, **A. S. Gardner**, L. Sørensen, and R. Forsberg (2016), Improved retrieval of land ice topography from CryoSat-2 data and its impact for volume change estimation of the Greenland Ice Sheet. *The Cryosphere*.
- Gilbert, A., G. E. Flowers, G. H. Miller, B. T. Rabus, W. Van Wychen, **A. S. Gardner**, and L. Copland (2016), Sensitivity of Barnes Ice Cap, Baffin Island, Canada, to climate state and internal dynamics, *Journal of Geophysical Research: Earth Surface*, 121(8), 1516-1539, doi:10.1002/2016JF003839.
- Behrangi, A., M. Christensen, M. Richardson, M. Lebsock, G. Stephens, G. J. Huffman, D. Bolvin, R. F. Adler, **A. Gardner**, B. Lambriksen and E. Fetzer (2016). Status of High latitude precipitation estimates from observations and reanalysis. *Journal of Geophysical Research*.

- Reager, J. T., **A. S. Gardner**, J. S. Famiglietti, D. N. Wiese, A. Eicker, and M.-H. Lo, (2016), A decade of sea level rise slowed by climate-driven hydrology, *Science*, 351(6274), 699-703, doi:10.1126/science.aad8386.
- Fahnestock, M., T. Scambos, T. Moon, **A. Gardner**, T. Haran, and M. Klinger (2016). Rapid large-area mapping of ice flow using Landsat 8, *Remote Sensing of the Environment*, doi:http://dx.doi.org/10.1016/j.rse.2015.11.023.
- Earl, L.\***, **A. S. Gardner** (2016). A Satellite Derived Glacier Inventory for North Asia. *Annals of Glaciology*, 57(71). 50-60.
- Flanner, M. G., **A. S. Gardner**, S. Eckhardt, A. Stohl, and J. Perket (2014). Aerosol radiative forcing from the 2010 Eyjafjallajökull volcanic eruptions. *Journal of Geophysical Research: Atmospheres*, 119, 9481-9491.
- Pfeffer, W.T., Arendt, A.A., Bliss, A., Bolch, T., Cogley, J.G., **Gardner, A.S.**, Hagen, J-O., Hock, R., Kaser, G., Kienholz, C., Miles, E.S., Moholdt, G., Moelg, N., Paul, F., Radic, V., Rastner, P., Raup, B., Rich, J., Sharp, M.J. and the Randolph Consortium (2014). The Randolph Glacier Inventory: a globally complete inventory of glaciers. *Journal of Glaciology*, 60, 537-552.
- Donnellan, A., B. Bills, J.J. Green, R. Goullioud, S. Jones, R. Knight, M. Underhill, J. Goguen, E. M. De Jong, A. Ansar, T. Scambos, P. Morin, B. Hallet, L. Thompson, **A.S. Gardner**, J. Ekholm (2014). Studying mountain glacier processes using a staring instrument. *Aerospace Conference, 2014 IEEE*, 1-17.
- Gardner, A.S.**, G. Moholdt, J.G. Cogley, B. Wouters, A.A. Arendt, J. Wahr, E. Berthier, R. Hock, W.T. Pfeffer, G. Kaser, S.R.M. Ligtenberg, T. Bolch, M.J. Sharp, J.O. Hagen, M.R. van den Broeke, and F. Paul (2013). A reconciled estimate of glacier contributions to sea level rise: 2003 to 2009. *Science*, 340, 852-857. (**Featured Article**)
- IPCC. 2013. Working Group 1 Contribution to the IPCC Fifth Assessment Report (AR5), Climate Change 2013: The Physical Science Basis. Chapter 4: Observations: Cryosphere. Co-ordinating Lead Authors: D.G. Vaughan, J.C. Comiso; Lead Authors: I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen, T. Zhang; Contributing Authors: A.A. Arendt, D.B. Bahr, M. van den Broeke, R. Brown, J.G. Cogley, **A.S. Gardner**, S. Gerland, S. Gruber, C. Haas, J-O. Hagen, R. Hock, D. Holland, M. Huss, T. Markus, B. Marzeion, R. Massom, G. Moholdt, P.P. Overduin, A. Payne, W.T. Pfeffer, T. Prowse, V. Radic, D. Robinson, M. Sharp, K. Shiklomanov, S. Smith, S. Stammerjohn, I. Velicogna, P. Wadhams, A. Worby, L. Zhao. 102pp.
- IPCC. 2013. Working Group 1 Contribution to the IPCC Fifth Assessment Report (AR5), Climate Change 2013: The Physical Science Basis. Chapter 13: Sea Level Rise. Co-ordinating Lead Authors: J. A. Church, P.U. Clark; Lead Authors: A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer, A.S. Unnikrishnan; Contributing Authors: D. Bahr, J.E. Box, D.H. Bromwich, M. Carson, W. Collins, X. Fettweis, P. Forster, **A.S. Gardner**, W.R. Gehrels, R. Giesen, P.J. Gleckler, P. Good, R.G. Graversen, R. Greve, S. Griffies, E. Hanna, M. Hemer, R. Hock, S.J. Holgate, J. Hunter, P. Huybrechts, G. Johnson, I. Joughin, G. Kaser, C. Katsman, L. Konikow, G. Krinner, A. Le Brocq, J. Lenaerts, S. Ligtenberg, C.M. Little, B. Marzeion, K.L. McInnes, S.H. Mernild, D. Monselesan, R. Mottram, T. Murray, G. Myhre, J.P. Nicholas, F. Nick, M. Perrette, D. Pollard, V. Radić, J. Rae, M. Rummukainen, C. Schoof, A. Slangen, J.H. van Angelen, W.J. van de Berg, M. van den Broeke, M. Vizcaíno, Y. Wada, N.J. White, R. Winkelmann, J. Yin, M. Yoshimori, K. Zickfeld. 124pp.

- Arendt, A., Luthcke, S., **Gardner, A.S.**, O'neel, S., Hill, D., Moholdt, G., and Abdalati, W. (2013). Analysis of a GRACE global mascon Solution for Gulf of Alaska Glaciers, *Journal of Glaciology*, 59, 913-924.
- Lenaerts, J.T.M., J.H. van Angelen, M.R. van den Broeke, **A.S. Gardner**, B. Wouters, and E. van Meijgaard (2013). Irreversible mass loss of Canadian Arctic Archipelago glaciers. *Geophysical Research Letters*, 40, 1-5.
- Gardner, A.S.**, G. Moholdt, A. Arendt, and B. Wouters (2012). Accelerated contributions of Canada's Baffin and Bylot Island glaciers to sea level rise over the past half century, *The Cryosphere*, 6, 1103-1125, 10.5194/tc-6-1103-2012.
- Moholdt, G., B. Wouters, and **A.S. Gardner** (2012). Recent mass changes of glaciers in the Russian High Arctic. *Geophysical Research Letters*, 39, L10502.
- Gardner, A.S.**, G. Moholdt, B. Wouters, G.J. Wolken, D.O. Burgess, M.J. Sharp, J.G. Cogley, C. Braun, and C. Labine (2011). Sharply increased mass loss from glaciers and ice caps in the Canadian Arctic Archipelago, *Nature*, 473(7347), 357-360. **(Cover Feature)**
- Kuipers Munneke, P., M.R. van den Broeke, J.T.M. Lenaerts, M. G. Flanner, **A.S. Gardner**, and W.J. van de Berg (2011). A new albedo parameterization for use in climate models over the Antarctic ice sheet. *Journal of Geophysical Research*, 116, D05114.
- Sharp, M., Burgess, D.O., Cawkwell, F., Copland, L., Davis, J.A., Dowdeswell, E.K., Dowdeswell, J.A., Gardner, A.S., Mair, D., Wang, L., Williamson, S.N., Wolken, G.J. and Wyatt, F. (2014). Remote sensing of recent glacier changes in the Canadian Arctic, in *Global Land Ice Measurements from Space*, edited by J. S. Kargel, G. J. Leonard, M. P. Bishop, A. Käab and B. H. Raup, pp. 205-228, Springer Berlin Heidelberg, Berlin, Heidelberg, doi:10.1007/978-3-540-79818-7\_9.
- Gardner, A.S.** and M.J. Sharp (2010). A review of snow and ice albedo and the development of a new physically based broadband albedo parameterization. *Journal of Geophysical Research*, 115, F01009.
- Gardner, A.S.**, M.J. Sharp, R. M. Koerner, C. Labine, S. Boon, S. J. Marshall, D. O. Burgess, and D. Lewis (2009). Near-surface temperature lapse rates over Arctic glaciers and their implications for temperature downscaling. *Journal of Climate*, 22, 4281-4298.
- Gardner, A.S.** and M.J. Sharp (2009). Sensitivity of net mass balance estimates to near-surface temperature lapse rates when employing the degree-day method to estimate glacier melt. *Annals of Glaciology*, 50, 80-86.
- Gardner, A.S.** and M. Sharp (2007). Influence of the Arctic Circumpolar Vortex on the mass balance of Canadian High Arctic glaciers. *Journal of Climate*, 20, 4586-4598.

#### PUBLICATIONS (OTHER)

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- Gardner, A.S.**, J.G. Cogley, E. Berthier, G. Kaser (2013). Comment: Take more care over glacier facts. *Nature*, 504. 33-33.
- Arendt, A., Bolch, T., Cogley, J. G., **Gardner, A.S.**, Hagen, J.-O., Hock, R., Kaser, et al. (2012). Randolph Glacier Inventory: A Dataset of Global Glacier Outlines Version: 2.0, Global Land Ice Measurements from Space, Boulder Colorado, USA. Digital Media.

#### GRANTS (FUNDED)

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**NASA MEaSURES (2018-2023)**

**\$4.2M**

*Inter-mission Time Series of Land Ice Velocity and Elevation (ITS LIVE):*

with **Alex Gardner** (PI, JPL), Piyush Agram (co-I, JPL), Hook Hua (co-I, JPL), Justin Linick (co-I, JPL), Johan Nilsson (co-I, JPL), Catherine Walker (co-I, JPL), Ted Scambos (co-I, U. Colorado, Boulder), Mark Fahnestock (co-I, U. Alaska, Fairbanks), Franz Meyer (co-I, U. Alaska, Fairbanks)

**NASA Sea Level Team (2017-2020) \$4M**

*Global interconnections of Cryosphere and Solid Earth, Sea-level Change and Ice Mass Balance* with Erik Ivins (PI, JPL), Eric Larour (co-I, JPL), Surendra Adhikari (co-I, JPL), Helene Seroussi (co-I, JPL), Dimitris Menemenlis (co-I, JPL), **Alex Gardner** (co-I, JPL), Nicole-Jeanne Schlegel (co-I, JPL), David Wiese (co-I, JPL), Johan Nilsson (co-I, JPL), Bill Hammond (co-I, U. Navada), Geoff Blewitt (co-I, U. Navada).

**NASA Cryospheric Sciences (2017-2019) \$750k**

*Constraining Mass Balance Uncertainties in East Antarctica from 2003 to the Present with Laser and Radar Altimetry Observations* with Ala Khazendar (PI, JPL), **Alex Gardner** (co-I, JPL), Nicole Schlegel (co-I, JPL)

**JPL President's and Director's Fund Proposal (2016-2017) \$300k**

*"Ice-shelf and ice stream dynamics"* with Ala Khazendar (PI, JPL), Mark Simons (PI, Caltech), Victor Tsai (co-I, Caltech), Piyush Agram (co-I, JPL), **Alex Gardner** (co-I, JPL), Helene Seroussi (co-I, JPL)

**NASA Cryospheric Sciences (2015-2018) \$613k**

*"Contributions of glaciers to sea level rise over the past half-century"* with **Alex Gardner** (PI, JPL), Michael Willis (co-I, Cornell), (co-I, AMES), Oleg Alexandrov, (co-I, AMES)

**NASA Cryospheric Sciences (2015-2018) \$993k**

*"Global Land Ice Velocity Extraction from Landsat (GoLIVE): A robust, comprehensive, and near-real-time record of global glacier flow"* with Ted Scambos (PI, UC Boulder), **Alex Gardner** (I-PI, JPL), Mark Fahnestock (I-PI, UA Fairbanks)

**NASA Cryospheric Sciences (2015-2018) \$1.1M**

*"Data assimilation of NASA altimetry into reconstructions of present-day state of the ice"* with Eric Larour (PI, JPL), **Alex Gardner** (co-I, JPL), Beata Csatho (co-I, UNY Buffalo), Ala Khazendar (co-I, JPL), Nicole-Jeanne Schlegel (co-I, JPL), Helene Seroussi (co-I, JPL)

**NASA Cryospheric Sciences (2015-2018) \$960k**

*"A peek at the past of the Greenland ice sheet using radar layers and modeling"* with Eric Larour (PI, JPL), **Alex Gardner** (co-I, JPL), Indrani Das (co-I, Lamont-Doherty Earth Observatory / Columbia U.), Joseph MacGregor (co-I, UT Austin)

**NASA Earth Surface and Interior (2015-2018) \$435k**

*"Geodetic Responses to Little Ice Age and Anthropocene Loading of the Mantle"* with Erik Ivins (PI, JPL), **Alex Gardner** (co-I, JPL), Surendra Adhikari (co-I, JPL), Gregory Lyzenga (co-I, JPL), David Wiese (co-I, JPL)

**GRACE SCIENCE TEAM (2015-2017) \$350k**

*"Using GRACE to advance precipitation analysis in cold regions"* with Ali Behrangi (PI, JPL), **Alex Gardner** (co-PI, JPL), JT Reager (co-I, JPL), Josh Fisher (co-I, JPL)

- ICESAT2 SCIENCE DEFINITION TEAM (2015-2017)** **\$235k**  
*"Improved interpretation of ICESat-2 data through characterization of multiple scattering of the laser micropulse"* with **Alex Gardner** (PI, JPL)
- JPL TOPIC AREA PROPOSAL FOR THE RESEARCH AND TECH. DEV. FUND (2015-2016)** **\$254k**  
*"Land Ice Changes using CryoSat-2 Data"* with **Alex Gardner** (PI, JPL), Erik Ivins (co-I, JPL), Eric Larour (co-I, JPL)
- NASA Cryospheric Sciences (2014-2017)** **\$900k**  
*"Glaciology and Sea Level Rise Research"* with **Alex Gardner** (PI, JPL)
- NASA Studies with ICESAT and CryoSat-2 (2013-2016)** **\$134k**  
*"Multiple Scattering Within Snow, Ice, Firn and Water and Its Impact on Elevation Retrievals from ICESat-2 Data"* with **Alex Gardner** (PI, Clark University) and Mark Flanner (co-PI, University of Michigan)

**TEACHING EXPERIENCE (SPRING/FALL YEAR: UNDERGRADUATE/GRADUATE ENROLMENT)**

**REMOTE SENSING OF THE CRYOSPHERE (S14: 3/17)**

*Graduate School of Geography, Clark University*

Undergraduate/graduate course covering satellite observation methods and analysis for cryosphere monitoring including laser altimetry, gravimetry, multi-spectral imagery, microwave radiometry, and radar.

**EARTH SYSTEM SCIENCE (S14: 75/0)**

*Graduate School of Geography, Clark University*

Undergraduate course introducing the structure and function of the Earth System. Topics covered included weather, climate, atmosphere and ocean circulation, hydrologic cycle, water resources, tectonics, and land-surface processes.

**INTRODUCTION TO REMOTE SENSING (F12: 15/21, F13: 19/26)**

*Graduate School of Geography, Clark University*

Undergraduate/graduate course covering the principles and analytical methods of satellite remote sensing as applied to environmental systems.

**INTRODUCTION TO QUANTITATIVE METHODS (S13: 22/2)**

*Graduate School of Geography, Clark University*

Undergraduate/graduate course focused on statistical methods.

**DIRECTED STUDY: ADVANCED TOPICS IN CRYOSPHERIC SCIENCES (S12: 1/1, F13: 1/1, S14: 2/1)**

*Graduate School of Geography, Clark University*

Undergraduate/graduate directed study covering a wide range of advanced cryosphere and earth system science topics.

**INVITED INSTRUCTOR: INTERNATIONAL SUMMER SCHOOL IN GLACIOLOGY (S12: 0/27)**

*Geophysical Institute, University of Alaska, Fairbanks*

Graduate seminar on methods for determining glacier mass change from space.

**GUEST LECTURER: ATMOSPHERIC MODELING (S10)**

*Department of Earth and Atmospheric Sciences, University of Alberta*

Three undergraduate/graduate lectures introducing scientific computing for climate research.

**GUEST LECTURER: ICE DYNAMICS & GLACIER HYDROLOGY (F09)**

*Department of Earth and Atmospheric Sciences, University of Alberta*

Three graduate lectures covering glacier surface mass and energy exchanges

**TEACHING ASSISTANT: PLANET EARTH (F09)**

*Department of Earth and Atmospheric Sciences, University of Alberta*

Instruction and grading of 10 labs introducing the origins and evolution of the Earth and the solar system.

**SERVICE**

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**CONTRIBUTING AUTHOR TO CHAPTER 4 (OBSERVATIONS: CRYOSPHERE) AND CHAPTER 13 (SEA LEVEL CHANGE) OF THE IPCC WORKING GROUP 1, FIFTH ASSESSMENT REPORT**

Contributed to the synthesis of global glacier mass change estimates and to the evaluation of projections of glacier change.

**BOARDS**

Advisory board member of the International Association of Cryospheric Sciences (IASC) Global Terrestrial Network - for Glaciers GTN-G) (2014-present)

Advisory board member for Global Land Ice Measurements from Space (GLIMS) (2014-present)

**MISSION REVIEW**

NASA NISAR pre-CDR / pre-PDR Peer Review (2016/2018)

NASA Europa Clipper REASON performance review (2017)

NASA ICESat-2 Algorithm Theoretical Basis Documents (2014-2015)

NASA Operation Ice Bridge mission review (2013-2014)

**SCIENCE TEAMS**

NASA ICESat-2 Science / Science Definition Team, P.I. (2014-present)

NASA GRACE/GRACE-FO Science Team, co-I. (2015-present)

NASA Sea Level Change Team, P.I./co-I. (2014-2017/2017-present)

**MISSION PROPOSALS**

Radar Orbital Sounder for Ice Exploration (ROSIE), Instrument Concept (2017-present)

Gates of Antarctica (GoA), Suborbital Concept, Principle Investigator (2016-2017)

Snow and Ice Radiative-Forcing Albedo (SIRFA), Mission Concept, Deputy-Scientist (2014-2017)

Orbiting Arid Subsurface & Ice Sheet Sounder – 2 (OASIS-2), Mission Concept, Team Member (2015- present)

Spatially Enhanced Glacier Altimetry (SEGA), Mission Concept, Principle Investigator (2014-2015)

Mission to Understand Ice Retreat (MUIR), Instrument Concept, Team Member (2014-2015)

**EDITORIAL DUTIES**

PLOS ONE - Member of Editor Board (2018 – present)

Remote Sensing – Special Issue - Remote Sensing of Glaciers at Global and Regional Scales (2018 – present)

**REVIEWER FOR SCIENTIFIC JOURNALS**



Reviewer for Nature, Science, Nature Climate Change, Nature Communications, Nature Geoscience, Nature Scientific Reports, Climate and Atmospheric Science – Nature, Geophysical Research Letters, Environmental Research Letters, Journal of Geophysical Research (Earth Surface and Atmospheres), Geology, Geochemistry Geophysics Geosystems (G-cube), Geology, Water Resources Research, The Cryosphere, PLOS ONE, Journal of Applied Meteorology and Climatology, IEEE Transactions on Geoscience and Remote Sensing, International Journal of Climatology, Journal of Glaciology, Polar Research, Water Science and Technology, Remote Sensing, and Arctic, Antarctic, and Alpine Research.

#### **REVIEWER OF GRANTS APPLICATIONS**

NASA Panelist (Earth and Space Science Fellowship Program; Modeling, Analysis and Prediction program, Cryosphere Program), and reviewer for the National Science Foundation (Arctic Natural Sciences Program; Antarctic Integrated System Science; Geography and Spatial Sciences Program), Netherlands Space Office (NSO), Icelandic Centre for Research, Netherlands Organization for Scientific Research: Earth and Life sciences, French Polar Institute (IPEV, Arctic Program), and the Swiss National Science Foundation (Div. Mathematics, Physical and Engineering Sciences).

#### **UNIVERSITY COMMITTEES**

Web Committee Chair, Graduate School of Geography, Clark University, (2013/14)  
Undergraduate Student Committee Member, Graduate School of Geography, Clark University, (2012/14)

#### **WORKING GROUPS**

IACS Working group Randolph Glacier Inventory and infrastructure for glacier monitoring (2014-present)

NASA Cryospheric Sciences Program's SURface Mass Balance and snow on sea ice (SUMup) Working Group (2012-2016)

NASA Snow Working Group (2013-2015)

#### **CONVENER OF AMERICAN GEOPHYSICAL UNION (AGU) FALL MEETING SCIENTIFIC SESSIONS**

Remote Sensing of Glaciers (December 2014, 2015, 2016)

The Changing Cryosphere (December 2012)

Cryosphere-Atmosphere Energy Exchanges: Advances in Modeling and Observation. (December 2011)

#### **MEDIA INTERVIEWS AND RESEARCH COVERAGE**

TV interview with Al Jazeera English. Radio interviews with the Canadian Broadcasting Corporation (CBC) program "Quirks and Quarks", CBC national news, Germany's Deutschlandfunk radio, and CKLB (NT, Canada) program "Ends of the Earth". Print interviews with the New York Times, British Broadcasting Corporation (BBC), Los Angeles Times, MSNBC, Physics Today, Space.com, Science News (USA), The Christian Science Monitor (USA), New Scientist, Postmedia News (Canada), American Geophysical Union, and LiveScience (USA). My research has been featured as NASA's Earth Observatory Image of the Day multiple times and by more than 100 media outlets across the globe including BBC News, New York Times, The Guardian, Reuters, Bloomberg, Nature News, Newsweek, Earth & Space Science News, MSNBC, USA Today, the Vancouver Sun, Discovery News, Huffington Post, and New Scientist.

#### **CONFERENCE COORDINATOR**

CliMA (Climate Modeling Alliance) Polar Climates Workshop, Caltech, Pasadena, Co-Organizer (2018)

International Coordination for Spaceborne Synthetic Aperture Radar Data Acquisition, Processing and Analysis for Earth Science and Applications, Co-Chair (2018)

Host, ICESat-2 Science Team Meeting, JPL, Pasadena, CA (2016 & 2018)

Organizer, Workshop on Arctic Glaciers, Kananaskis, Alberta (2009)

## FIELD RESEARCH EXPERIENCE

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11 weeks of research experience conducting scientific measurements in remote and extreme Arctic environments. Through these research expeditions I acquired invaluable collaboration, leadership, and logistical planning skills that I could not have learned elsewhere. I also gained technical expertise in erecting satellite transmitting weather stations, conducting dynamic and static GPS surveys, logging snow stratigraphies and ice cores, monitoring firn compaction rates, setting up time lapse camera networks, drilling shallow ice cores, and carrying out dye tracing experiments.

## RESEARCH AND ACADEMIC ADVISING

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- Chad Greene, Advisor JPL/NASA (Postdoc, 2019-present)
- Fernando Paolo, Advisor, JPL/NASA (Postdoc, 2017-present)
- Amuary Dehecq, Advisor, JPL/NASA (Postdoc, 2016- present)
- Catherine Walker, Advisor, JPL/NASA (Postdoc, 2015-2018) [Now at NASA GSFC]
- Johan Nilsson, Advisor, JPL/NASA (Postdoc, 2015-2018) [Now at NASA JPL]
- Arthur Elmes, Committee, Clark University (Ph.D., 2017)
- Lucas Earl, Chair, Clark University (BA/M.Sc., 2014/15) [Now at The Institute for Health Metrics and Evaluation]
- Christopher Ferraro, Chair, Clark University (M.Sc., 2014) [Now at Dito]
- Emily Sturdivant, Honors Committee 2013, Clark University (B.A., 2013)[Now at USGS]
- Aku Riihelä, External Examiner, Aalto University, Finland (Ph.D. 2013) [Now at Finnish Meteorological Institute]

## Visiting Students

- Natalia Andersen, DTU Space (Ph.D., 2018)
- Jelte van Oostveen, Norwegian Polar Institute (Ph.D., 2017)
- Joseph Cook, University of Sheffield (Postdoc, 2016)

## PRESENTATIONS (INVITED)

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**Gardner, A. S.** In Hot Water: Glacier Change and Sea Level Rise. The von Kármán Lecture Series, Pasadena, California, USA. Invited Oral Presentation.

**Gardner, A. S.** G. Moholdt, T. Scambos, M. Fahnestock, A. Dehecq, 2016. A global dataset of glacier and ice sheet surface velocities derived from the Landsat archive. American Geophysical Union Fall Meeting, San Francisco, California, USA. Invited Oral Presentation.

**Gardner, A. S.**, 2016. Glaciers Contributions to Sea Level Rise. 3rd Sea-Level Rise Summit: Connected Futures from Alaska to Florida, Fort Lauderdale, Florida. **Invited Keynote Presentation.**

**Gardner, A. S.**, C. Boening, 2016. Glaciers and Sea Level Rise. Briefing for Congressman John Culberson, JPL-NASA, Pasadena, California, USA.

- Gardner, A. S.** J. G. Cogley, G. Moholdt, D. Wiese, B. Wouters, 2015. Glaciers Contributions to Sea Level Rise. American Geophysical Union Fall Meeting, San Francisco, California, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2015. Out of equilibrium in a warming world. Caltech, Pasadena, CA, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2015. Out of equilibrium in a warming world. York University, Toronto, ON, Canada. Invited Oral Presentation.
- Gardner, A. S.**, 2014. Glacier wastage and sea level rise. Ohio State, Columbus, OH, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2014. Glaciers and sea level rise. University of Innsbruck. Innsbruck, Austria. Invited Oral Presentation.
- Gardner, A. S.**, G. Moholdt, J. G. Cogley, B. Wouters, J. Wahr, 2014. Improved estimates of the global glacier contribution to sea level rise, European Geophysical Union. Vienna, Austria. Invited Oral Presentation.
- Gardner, A. S.**, 2013. Out of Equilibrium in a Warming World: Glacier Wastage and Sea Level Rise, Bromery Lecture, Johns Hopkins University. Baltimore, MD, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2013. Global glacier contributions to sea level rise, NASA Goddard Space Flight Center, Greenbelt, MD, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2013. Out of equilibrium in a warming world: using ICESat, GRACE and in situ observations to quantify global glacier contributions to sea level rise, Science Visitor and Colloquium Program, NASA's Jet Propulsion Laboratory. Pasadena, CA, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2013. Observing glacier change from space, New England - Saint Lawrence Valley Geographical Society, Clark University. Worcester, MA, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2013. Global glacier contributions to sea level rise. Sherbrook University, Sherbrook, Quebec, Canada. Invited Oral Presentation.
- Gardner, A. S.**, 2013: Surface mass budget of Canadian Arctic Glaciers. Surface Mass Balance and snow on sea ice (SUMup) Working Group meeting, NASA Goddard Space Flight Center, Greenbelt, MD, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2013. Out of Equilibrium in a Warming World: Glacier Wastage and Sea Level Rise, Marsh Lecture Series, Clark University. Worcester, MA, USA. Invited Oral Presentation.
- Gardner, A. S.**, G. Moholdt, J. G. Cogley, B. Wouters and J. Wahr, 2013: Global contribution of glacier wastage to sea level rise. Ice2sea North/South glacier workshop. Copenhagen, Denmark. Invited Oral Presentation.
- Gardner, A. S.**, 2013: Global contribution of glacier wastage to sea level rise. Ice2sea North/South glacier workshop. Copenhagen, Denmark. Invited Oral Presentation.
- Gardner, A. S.**, 2012: Surface mass budget of Canadian Arctic Glaciers. Surface Mass Balance and snow on sea ice (SUMup) Working Group meeting, NASA Goddard Space Flight Center in Greenbelt, MD, USA. Invited Oral Presentation.
- Gardner, A. S.**, 2012: Glaciers and Sea Level Rise, Department of Atmospheric & Environmental Sciences, University at Albany, SUNY, NY, USA. Invited Oral Presentation.

**Gardner, A. S.**, 2011: How much are glaciers contributing to Sea Level, Clark Graduate School of Geography, Clark University, Worcester, MA, USA. Invited Oral Presentation.

**Gardner, A. S.**, 2010: Melting of Glaciers and Ice Sheets: Towards Improved Estimates. Atmospheric, Oceanic, and Space Science Department Winter Seminar Series, University of Michigan, Ann Arbor, Michigan, USA. Invited Oral Presentation.

## PRESENTATIONS

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**Gardner, A.S.**, M.A. Fahnestock, P.S. Agram, T. Scambos, J. Nilsson, F.S. Paolo, C.C. Walker, F.J. Meyer, A. Dehecq. ITS\_LIVE: A new NASA MEaSUREs initiative to track the movement of the world's ice, 2018. American Geophysical Union Fall Meeting, Washington, DC, USA. Oral Presentation.

**Gardner, A. S.**, 2015. Observing Glacier Changes in High Mountain Asia from Space. 3<sup>rd</sup> CAS-NASA Workshop on High Mountain Asia Glaciers Change and Associated Hazards. Sanya, China. Oral Presentation.

**Gardner, A. S.**, G. Moholdt, T. Scambos, M. Fahnestock, 2015. What can we learn about glaciers and ice sheets from 30 years of Landsat imagery? American Geophysical Union Fall Meeting, San Francisco, California, USA. Poster.

**Gardner, A. S.**, G. Moholdt, J. G. Cogley, B. Wouters and J. Wahr, 2013: Glacier Contributions to Sea Level Rise: 2003-2009, NASA Program for Arctic Regional Climate Assessment annual meeting, Greenbelt, MD, USA. Oral Presentation.

**Gardner, A. S.**, G. Moholdt, J. G. Cogley, A. A. Arendt, J. Wahr: Narrowing the gap: A consensus estimate of glacier mass wastage for 2003-09. 2012 American Geophysical Union Fall Meeting, San Francisco, California, USA. Poster Presentation.

**Gardner, A. S.**, G. Moholdt, B. Wouters, A. Arendt, 2011: Canadian Arctic Archipelago Glacier Contributions to Sea Level: 1950-2011. 2011 American Geophysical Union Fall Meeting, San Francisco, California, USA. Oral Presentation.

**Gardner, A. S.**, G. Moholdt, J. G. Cogley, B. Wouters and J. Wahr, 2013: Glacier Contributions to Sea Level Rise: 2003-2009, NASA Program for Arctic Regional Climate Assessment annual meeting, Greenbelt, MD, USA. Oral Presentation.

**Gardner, A. S.** and M. G. Flanner. The need for improving the simulation of glacier surface energy and mass budgets within CESM. 2011: Community Earth Systems Model Annual Workshop, Breckenridge, Colorado, USA. Oral Presentation.

**Gardner, A. S.**, G. J. Wolken, M. J. Sharp, G. Moholdt, B. Wouters, D. O. Burgess, J. G. Cogley: Estimating the mass change of Canadian High Arctic glaciers (1949-2010). 2010 American Geophysical Union Fall Meeting, San Francisco, California, USA. Oral Presentation.

**Gardner, A. S.** and M. Sharp, 2009: Parameterization of Shortwave Absorption and Reflection by Snow and Ice. 2009 American Geophysical Union Fall Meeting, San Francisco, California, USA. Oral Presentation.

**Gardner, A. S.**, 2009: Snow Albedo. ATLAS Symposium, Edmonton, AB, Canada. Oral Presentation.

**Gardner, A. S.**, 2009: Parameterization of Shortwave Absorption and Reflection in Snow and Ice. IASC Workshop on the dynamics and mass budget of Arctic glaciers, Kananaskis Country, AB, Canada. Oral Presentation.

**Gardner, A. S.**, and M. Sharp, 2008: The importance of including variable near-surface temperature lapse rates when employing the degree-day method to estimate glacier

melt. Workshop on Mass Balance Measurements and Modelling, Skeikampen, Norway.  
Oral Presentation.

**Gardner, A. S.**, 2007: Meteorological and climatic influences on Canadian high Arctic glacier surface melt. CSA-CCI Northern Research Day, Edmonton, AB. Oral Presentation.

**Gardner, A. S.**, and M. Sharp, 2006: Influence of Variability in the Circumpolar Vortex on the Mass Balance of Canadian High Arctic Glaciers. Geological Association of Canada - First Open Scientific Meeting of the Polar Climate Stability Network, Montréal, QC. Oral Presentation. **(Honorable Mention from the Geological Association of Canada)**

**Gardner, A. S.**, and M. Sharp, 2006: Influence of the Arctic Circumpolar Vortex on the Mass Balance of Canadian high Arctic Glaciers. Eighth Symposium on Research in Geosciences, Edmonton, AB. Oral Presentation.

**Gardner, A. S.**, M. Sharp, 2006: Can Stratospheric Ozone Loss Influence Arctic Glacier Surface Mass Balance? CSA-CCI Northern Research Day, Edmonton, AB. Oral Presentation.

**Gardner, A. S.**, M. Sharp, 2006: Synoptic-Scale Climatic Variability and Glacier Mass Balance of the Queen Elizabeth Islands. Canadian Geophysical Union Hydrology Section Fourth Annual Student Meeting, Edmonton, AB. Oral Presentation.

**Gardner, A. S.**, and M. Sharp, 2005: Influence of Atmospheric Circulation Changes on Canadian High Arctic Glaciers. Second ArcticNet Annual Scientific Meeting, Banff, AB. Poster Presentation.

**Gardner, A. S.**, and M. Sharp, 2005: Climatic Influences on the Mass Balance of Canadian high Arctic Glaciers. Seventh Symposium on Research in Geosciences, Edmonton, AB. Oral Presentation.