

# NATALIE S. WOLFENBARGER

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## RESEARCH STATEMENT

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I study terrestrial ice to inform interpretation of ice-penetrating radar data collected by radar instruments on upcoming missions to icy ocean worlds. I pursue this research to understand how future observations could be used to constrain Europa's potential for life.

## EDUCATION

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### University of Texas, Austin

Ph.D. Geophysics

Dec 2022

*Terrestrial constraints on the distribution of brine in Europa's ice shell*

M.S. Aerospace Engineering

May 2017

*Characterization of star tracker distortion for the ICESat mission*

### California Polytechnic State University, San Luis Obispo

B.S. Aerospace Engineering

Dec 2013

*CubeSat orbit prediction and simulation from deployment conditions*

## WORK & INTERNSHIP EXPERIENCE

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### Stanford University

Jan 2023 – Present

Postdoctoral Scholar

Stanford, CA

### Institute for Geophysics

Jun 2017 – Dec 2022

Graduate Research Assistant

Austin, TX

### Center for Space Research

Aug 2014 – May 2017

Graduate Research Assistant

Austin, TX

### SpaceX

Jan 2014 – Apr 2014

Dynamics Intern

Hawthorne, CA

### Cal Poly CubeSat

Jul 2011 – Dec 2013

Undergraduate Research Assistant

San Luis Obispo, CA

### NASA Goddard Space Flight Center

Jun 2012 – Sep 2012

Propulsion Intern

Greenbelt, MD

## MISSION EXPERIENCE

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### NASA Europa Clipper

Postdoctoral Affiliate Member, Europa Clipper Science Team

2023 – Present

Member, REASON Science Management Team

2023 – Present

Member, REASON Experiment Management Team

2023 – Present

Member, REASON Operations Working Group

2023 – Present

Member, Habitability Assessment Board

2021 – Present

Member, REASON Science Verification and Validation Team

2018 – Present

Member, Interior Working Group

2018 – Present

Member, Composition Working Group

2018 – Present

Member, Habitability Working Group

2018 – 2021

Graduate Student Affiliate Member, Europa Clipper Science Team

2018 – 2022

## FIELD EXPERIENCE

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|                                                                                                                                                                                         |                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Thwaites Glacier, Antarctica</b>                                                                                                                                                     | Dec 2019 – Feb 2020 |
| <i>Land-Ice/Ocean Network Exploration with Semiautonomous Systems: Thwaites Glacier (LIONESS/TG)</i>                                                                                    |                     |
| <b>Nunavut, Canadian High Arctic</b>                                                                                                                                                    | May 2018 – Jun 2018 |
| <i>SEARCH<sup>Arctic</sup> (SRH1)</i>                                                                                                                                                   |                     |
| Supported airborne polar field expeditions through survey planning, operational logistics, instrument integration and test, and preliminary data analysis (radar, altimetry, magnetics) |                     |

## FELLOWSHIPS & AWARDS

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|----------------------------------------------------------------|-----------|
| Center for Planetary Systems Habitability Student Travel Grant | 2022      |
| UTIG Fellowship                                                | 2021      |
| UTIG Graduate Student Award                                    | 2020      |
| Zonta International Amelia Earhart Fellowship                  | 2019      |
| International Glaciological Society (IGS) Travel Grant         | 2019      |
| Jackson School Research Symposium Honorable Mention            | 2019      |
| Graduate And Industry Networking (GAIN) Research Award         | 2017      |
| Cockrell School of Engineering Multi-Year Fellowship           | 2014–2017 |
| Texas Space Grant Consortium Fellowship                        | 2015      |
| University of Texas at Austin Graduate School Fellowship       | 2014–2015 |
| Cal Poly Outstanding Woman in Engineering Nominee              | 2013      |

## GRANTS

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|------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Stanford Doerr Discovery Grant</b>                                                                                                          | 2024 – 2025 |
| <i>Lead-Writer</i> , Following water through ice shells with radar by bridging hydrologic permeability and dielectric permittivity (\$143,076) |             |
| <b>NASA Interdisciplinary Research in Earth Science</b>                                                                                        | 2023 – 2026 |
| <i>Collaborator</i> , Diagnosing Sub-Ice Ocean Processes with Basal Radar Reflectometry: An Analogue for Icy Ocean Worlds                      |             |
| <b>NASA Precursor Science Investigations for Europa (PSIE)</b>                                                                                 | 2023 – 2026 |
| <i>Collaborator</i> , Follow the Energy: Tracing from Europa Surface Chemistry Back to Subsurface Redox Conditions                             |             |

## INVITED TALKS

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|                                                                                       |      |
|---------------------------------------------------------------------------------------|------|
| 11. The Potential for Salt Layers as Radar-Detectable Structure in Europa's Ice Shell | 2024 |
| <i>Stanford Geophysics Seminar</i>                                                    |      |
| 10. Ingredients for interpreting future radar observations of Europa                  | 2023 |
| <i>Southwest Research Institute Colloquium</i>                                        |      |
| 9. Geochemical Constraints on the Multiphase Behavior of Ice                          | 2023 |
| <i>Maths on Ice</i>                                                                   |      |
| 8. Terrestrial Constraints on the Distribution of Brine in Europa's Ice Shell         | 2023 |
| <i>UC Santa Cruz Planetary Lunch (PLUNCH) Seminar</i>                                 |      |
| 7. Terrestrial Constraints on the Distribution of Brine in Europa's Ice Shell         | 2022 |
| <i>Freie Universität Berlin Planetologie Seminar</i>                                  |      |
| 6. Non-Ice Impurities as a Source of Radar Reflections from Europa's Interior         | 2022 |
| <i>Europa Clipper Composition Working Group</i>                                       |      |
| 5. Brine Pocket Habitat's in Europa's Ice Shell                                       | 2022 |
| <i>Oceans Across Space and Time</i>                                                   |      |

4. The Salinity of Europa's Ice Shell: Insights from Accreted Ice on Earth 2022  
*Europa Clipper Lecture Series*
3. Ice Shell Structure and Composition of Ocean Worlds 2021  
*JPL ICE Seminar*
2. REASON Deep Ice Shell Composition Models 2021  
*Europa Clipper Composition Working Group*
1. Adding Salinity to the Ice Data Sets 2020  
*SESAME Subsurface Modeling Workshop*

## PROFESSIONAL SERVICE

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**Leadership Team** Europa Clipper Sunrise (2023 – Present), Stanford Radio Glaciology (2023 – Present), Cal Poly Society of Women Engineers (2012 – 2013), Cal Poly Engineering Student Council (2009 – 2011)

**Guest Editor** [Icarus Special Issue on Ices in the Solar System \(2023 – Present\)](#)

**Reviewer, Proposals** NASA Solar System Workings

**Reviewer, Journals** Nature Communications, ACS Earth and Space Chemistry, JGR: Planets, Planetary Science Journal, Oceanography

**Session Convener** [Goldschmidt \(2024\)](#), [AbSciCon \(2022\)](#)

**Session Moderator** Ancient & Future Brines Conference (2023), Modern Brines Conference (2021)

**Tiger Team** [Inspiring Clipper: Opportunities for Next-generation Scientists \(2023 – 2024\)](#)

**Task Force** Jackson School of Geosciences Culture & Climate (2018)

## ADVISING EXPERIENCE

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Ethan Scott (Undergraduate), *Measuring Dielectric Properties: Inclusion Shape* 2024  
 Annie Cheng (PhD Student), *Brine Transport in Europa's Ice Shell* 2024  
 Riley Shaper (Undergraduate), *Dielectric Mixing Models* 2023–2024  
 Duncan Findlay (High School), *Thickness of Salt Layers in Europa's Shallow Subsurface* 2022  
 Heidi Jackson (Undergraduate), *Sea Ice Geochemical Modeling* 2021  
 Madeleine Maylath (High School), *Marine Ice Accretion Under Amery Ice Shelf* 2018

## OUTREACH

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[Europa Clipper Here to Observe \(H2O\)](#) (mentor) 2022 – 2024  
[Exploring by the Seat of Your Pants, Daily Dive](#) (contributor) 2022  
[Event Horizon](#) (youtube interview) 2022  
[KXAN](#) (television interview) 2022  
[KUT](#) (radio interview) 2022  
[Girlstart Back to School STEM Saturday](#) (exhibitor) 2019  
[Hot Science Cool Talks](#) pre-lecture fair (exhibitor) 2019  
[STEM Enhancement in Earth Science \(SEES\) Summer High School Intern Program](#) (volunteer) 2016  
[STEM Girl Day at UT Austin](#) (volunteer) 2015, 2016, 2017

## PRESS

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**Wolfenbarger et al. (2022)** *Astrobiology*, **22(8)**, 937-961

UT Press Release: [Underwater Snow Gives Clues About Europa's Icy Shell](#)

Related Articles (Selected): [CNN](#), [New Scientist](#), [IGN](#), [Live Science](#), [SYFY Wire](#), [Science Daily](#), [SciTechDaily](#), [Space.com](#)

**Steinbrügge et al. (2020)** *Geophysical Research Letters*, **47(21)**, e2020GL090797

Stanford Press Release: [Researchers model eruption on Jupiter's moon Europa](#)

## PUBLICATIONS

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14. **N. S. Wolfenbarger**, ... (202X) Radar Characterization of Salt Layers in Europa's Ice Shell as a Window into Critical Ice-Ocean Exchange Processes . In Review at *Geophysical Research Letters*.
13. D. D. Blankenship, A. Moussessian, ... **N. S. Wolfenbarger (corresponding author)**, ... (202X) The Radar for Europa Assessment and Sounding: Ocean to Near-surface (REASON). In review at *Space Science Reviews*.
12. A. Romero-Wolf, G. Steinbrügge, J. Castillo-Rogez, C.J. Cochran, T.A. Nordheim, K.L. Mitchell, **N.S. Wolfenbarger**, D.M. Schroeder, S. Peters (2024) [Feasibility of Passive Sounding of Uranian Moons using Uranian Kilometric Radiation](#). *Earth and Space Science*, 11(2), e2023EA003013.
11. S. D. Vance, K. L. Craft, ... **N. S. Wolfenbarger**, ... (2023) [Investigating Europa's Habitability with the Europa Clipper](#). *Space Science Reviews*, 219(6), 81.
10. J. H. Roberts, W. B. McKinnon, ... **N. S. Wolfenbarger**, ... (2023) [Exploring the Interior of Europa with the Europa Clipper](#). *Space Science Reviews*, 219(6), 46.
9. O. Souček, M. Běhouňková, D. M. Schroeder, **N. S. Wolfenbarger**, K. Kalousová, G. Steinbrügge, K. M. Soderlund (2023) [Radar Attenuation in Enceladus' Ice Shell: Obstacles and Opportunities for Constraining Shell Thickness Science, Chemistry, and Thermal Structure](#). *JGR: Planets*, 128(2), e2022JE007626.
8. **N. S. Wolfenbarger**, M. G. Fox-Powell, J. J. Buffo, K. M. Soderlund, and D. D. Blankenship (2022) [Brine volume fraction as a habitability metric for Europa's ice shell](#). *Geophysical Research Letters*, 49(22), e2022GL100586.
7. **N. S. Wolfenbarger**, M. G. Fox-Powell, J. J. Buffo, K. M. Soderlund, and D. D. Blankenship (2022) [Compositional controls on the distribution of brine in Europa's ice shell](#). *JGR: Planets* 127(9), e2022JE007305.
6. **N. S. Wolfenbarger**, J. J. Buffo, K. M. Soderlund, and D. D. Blankenship (2022) [Ice shell structure and composition of ocean worlds: insights from accreted ice on Earth](#). *Astrobiology* 22(8), 937-961.
5. A. Rutishauser, D. D. Blankenship, D. A. Young, **N. S. Wolfenbarger**, L. H. Beem, M. L. Skidmore, A. Dubnick, and A. S. Criscitiello (2021) [Radar sounding survey over Devon Ice Cap indicates the potential for a diverse hypersaline subglacial hydrological environment](#). *The Cryosphere* 16(2), 379-395.
4. **N. S. Wolfenbarger**, E. Carnahan, J. Jordan, and M. A. Hesse (2021) [A comprehensive dataset for the thermal conductivity of ice Ih for application to planetary ice shells](#). *Data in Brief* 36, 107079.
3. E. Carnahan, **N. S. Wolfenbarger**, J. Jordan, and M. A. Hesse (2021) [New insights into temperature-dependent ice properties and their effect on ice shell convection for icy moons](#). *Earth and Planetary Science Letters* 563, 116886.
2. G. Steinbrügge, J. R. C. Voigt, **N. S. Wolfenbarger**, C. W. Hamilton, K. M. Soderlund, D. A. Young, D. D. Blankenship, S. D. Vance, and D. M. Schroeder (2020) [Brine migration and impact-induced cryovolcanism on Europa](#). *Geophysical Research Letters* 47(21), e2020GL090797.
1. C. A. Greene, K. Thirumalai, K. A. Kearney, J. M. Delgado, W. Schwanghart, **N. S. Wolfenbarger**, K. M. Thyng, D. E. Gwyther, A. S. Gardner, D. D. Blankenship (2019) [The climate data toolbox for MATLAB](#). *Geochemistry, Geophysics, Geosystems* 20(7), 3774–3781.

## BOOK CHAPTERS

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1. S. M. Howell, C. J. Bierson, K. Kalousová, E. Leonard, G. Steinbrügge, and **N. S. Wolfenbarger** (2023) [Jupiter's ocean worlds: Dynamic ices and the search for life](#) *Ices in the Solar-System: A Volatile-Driven Journey from the Inner Solar System to its Far Reaches*.

## TECHNICAL REPORTS & WHITE PAPERS

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4. C. Gerekos, D. A. Young, **N. S. Wolfenbarger**, K. Chan (2022) Allowable Uncertainties in Key Radar Parameters. IOM-REASON-2022-004.
3. D. A. Young, **N. S. Wolfenbarger**, K. M. Scanlan, G. B. Steinbrügge, K. Chan, C. Gerekos, D. D. Blankenship (2022) Model Physics for REASON Verification and Validation of Measurement Quality Requirements for Sounding, Reflectometry, and Altimetry. IOM-REASON-2022-002.
2. C. Gerekos, D. A. Young, **N. S. Wolfenbarger**, K. M. Scanlan, G. B. Steinbrügge, K. Chan, D. D. Blankenship (2022) REASON Measurement Quality Requirement Verification and Validation: An Approach using Canonical Clutter Discrimination Models of Europa for VHF Interferometry. IOM-REASON-2022-001.
1. D. A. Young, **N. S. Wolfenbarger**, T. G. Richter, C. Grima, K. M. Scanlan, G. B. Steinbrügge, K. Chan, Krista M. Soderlund, D. D. Blankenship (2019) REASON Measurement Quality Requirement Verification and Validation: A nadir link budget approach using 1D point models of Europa for Radar Sounding, Reflectometry, and Altimetry. IOM-REASON-2019-001.

## CONFERENCE PARTICIPATION

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28. **N. S. Wolfenbarger**, D. M. Schroeder, D. D. Blankenship. [From Sea Ice to Icy Shells: Modeling the Dielectric Properties of Ice-Brine Mixtures](#). *EGU* (2024) Poster Presentation.
27. D. M. Schroeder, **N. S. Wolfenbarger**, G. Steinbrügge. [Constraining the Thickness of the Conductive Portion Europa's Ice Shell using Sparse Radar Echoes](#). *EGU* (2024) Invited Oral Presentation.
26. J. Kowalski, A. Plesa, M. Boxberg, J. Buffo, K. Kalousová, J. Kerch, M. G. Llorens, M. Montagnat, T. Rückriemen-Bez, D. Schroeder, A. L. Simson, C. Sotin, K. Stephan, B. Terschanski, G. Tobie, **N. S. Wolfenbarger**. [Compiling analysis-ready ice data across cryosphere disciplines](#). *EGU* (2024) Poster Presentation.
25. **N. S. Wolfenbarger**, K. M. Scanlan, D. Findlay, D. A. Young, D. M. Schroeder, D. D. Blankenship. [Salt Layers as Radar-Detectable Structure within Europa's Ice Shell](#). *AGU Fall Meeting* (2023) Oral Presentation.
24. D. D. Blankenship, A. Moussessian, E. Chapin, D. A. Young, G. W. Patterson, J. Plaut, A. P. Freedman, D. M. Schroeder, C. Grima, G. Steinbrügge, K. M. Soderlund, T. L. Ray, T. G. Richter, L. Jones-Wilson, **N. S. Wolfenbarger**, K. M. Scanlan, C. Gerekos, K. Chan, I. Seker, M. Haynes, A. C. Barr Mlinar, L. Bruzzzone, B. A. Campbell, L. M. Carter, C. Elachi, Y. Gim, A. Herique, H. Hussmann, W. W. Kofman, W. S. Kurth, M. Mastrogiuseppe, W. B. McKinnon, J. M. Moore, F. Nimmo, C. S. Paty, D. Plettemeier, B. Schmidt, M. Y. Zolotov, P. Schenk, T. Urban. [Radar for Europa Assessment and Sounding: Ocean to Near-surface \(REASON\)](#). *AGU Fall Meeting* (2023) Poster Presentation.
23. **N. S. Wolfenbarger**. [Ice-Penetrating Radar: A Tool for Studying Cryospheres on Earth and Across the Solar System](#). *Bay Area Planetary Science Forum* (2023) Oral Presentation.
22. E. Leonard, I. Belgacem, K. Chan, A. Green, B. Mamo, H. Meyer, I. Mishra, N. Park, C. Psarakis, E. Spiers, M. Styczinski, K. Trinh, M. Velez, **N. S. Wolfenbarger**. [Europa Clipper Sunrise](#). *DPS-EPSC* (2023) Oral Presentation.

21. A. Romero-Wolf, G. Steinbrügge, J. Castillo-Rogez, C.J. Cochran, T.A. Nordheim, K.L. Mitchell, **N. S. Wolfenbarger**, D.M. Schroeder, S. Peters. [Passive Sounding of Uranian Moons Using Uranian Kilometric Radiation](#). *Uranus Flagship Workshop* (2023) Oral Presentation.
20. **N. S. Wolfenbarger**, K. M. Scanlan, D. Findlay, D. A. Young, D. M. Schroeder, D. D. Blankenship. [Detecting Fossil Brines within Europa's Ice Shell using Ice-Penetrating Radar](#). *Brines Across the Solar System: Ancient & Future Brines* (2023) Oral Presentation.
19. D. D. Blankenship, D. A. Young, K. Chan, **N. S. Wolfenbarger**, C. Gerekos, G. B. Steinbrügge. [Exploring Europa, Jupiter's Ocean World: A View from Earth](#). *EGU* (2023) Invited Oral Presentation.
18. C. Gerekos, A. Rutishauser, K. Scanlan, **N. S. Wolfenbarger**, L. Beem, J. Bott, D. Blankenship. [Airborne radar radiometry and coastline mapping of the highly-specular subglacial terrain on Devon island](#). *EGU* (2023) Poster Presentation.
17. M. G. Fox-Powell, **N. S. Wolfenbarger**, J.J. Buffo, J. Semprich, N. K. Ramkissoon. [Modelling Possible Chemical Evolution Pathways During Freezing of Europa's Ice Shell](#). *Lunar and Planetary Science Conference* (2023) Oral Presentation.
16. **N. S. Wolfenbarger**, K. M. Soderlund, and D. D. Blankenship. [A Sea Ice Approach to Modeling Bulk Density Variations Caused by Non-ice Impurities](#). *1st Workshop on Ices in the Solar System* (2023) Oral Presentation.
15. D. M. Schroeder, O. Souček, **N. S. Wolfenbarger**, K. Kalousová, M. Běhouňková, G. Steinbrügge, K. M. Soderlund. [Radar Attenuation in Enceladus' Ice Shell: Obstacles and Opportunities for Constraining Shell Thickness, Chemistry, and Thermal Structure](#). *AGU Fall Meeting* (2022) Poster Presentation.
14. D. Findlay, **N. S. Wolfenbarger**, C. Chivers, D. D. Blankenship, D. A. Young. [Thickness of Salt Layers Precipitated from Sills in Europa's Shallow Subsurface](#). *AGU Fall Meeting* (2022) Poster Presentation.
13. **N. S. Wolfenbarger**, M. G. Fox-Powell, J. J. Buffo, K. M. Soderlund, and D. D. Blankenship. [Brine Volume Fraction as a Habitability Metric for Europa's Ice Shell](#). *AbSciCon* (2022) Oral Presentation.
12. **N. S. Wolfenbarger**, M. G. Fox-Powell, J. J. Buffo, K. M. Soderlund, and D. D. Blankenship. [Models for the Volume Fraction of Brine in Equilibrium with Ice on Earth and Across the Solar System](#). *Lunar and Planetary Science Conference* (2022) Poster Presentation.
11. **N. S. Wolfenbarger**, M. G. Fox-Powell, J. J. Buffo, K. M. Soderlund, and D. D. Blankenship. [A Framework for Modeling the Distribution of Brine and Salt in an Ice Shell](#). *Brines Across the Solar System: Modern Brines* (2021) Oral Presentation.
10. M. A. Hesse, **N. S. Wolfenbarger**, and C. McCarthy. [To Percolate or Not to Percolate? When are Brines in Planetary Ice Shells Mobile?](#) *Brines Across the Solar System: Modern Brines* (2021) Oral Presentation.
9. E. Carnahan, **N. S. Wolfenbarger**, J. Jordan, and M. A. Hesse. [Effect of temperature-dependent material properties on ice shell convection](#). *AGU Fall Meeting* (2020) Oral Presentation.
8. J. R. C. Voigt, G. Steinbrügge, **N. S. Wolfenbarger**, C. W. Hamilton, K. M. Soderlund, D. A. Young, S. D. Vance, D. M. Schroeder, and D. D. Blankenship. [Melt Mobilization on Europa and its Application to Manannán Crater](#). *Lunar and Planetary Science Conference* (2020) Poster Presentation.
7. D. A. Young, D. D. Blankenship, **N. S. Wolfenbarger**, K. M. Soderlund, K. Chan, T. G. Richter, and the REASON Science Team. [An Ensemble of Point Models Approach for Science Verifica-](#)



- tion and Validation for Europa Clipper's Reason (Radar for Europa Assessment and Sounding: Ocean to Near-Surface) Investigation. *Lunar and Planetary Science Conference* (2020) Poster Presentation.
6. **N. S. Wolfenbarger**, K. M. Soderlund, and D. D. Blankenship. [Properties of Accreted Ices on Icy Ocean Worlds as Fingerprints of Sub-Ice Oceans](#). *AGU Fall Meeting* (2019) Oral Presentation.
  5. **N. S. Wolfenbarger**, K. M. Soderlund, and D. D. Blankenship. [Revisiting the Salt Distribution Coefficient for Icy Ocean Worlds](#). *Ocean Worlds 4* (2019) Poster Presentation.
  4. M. M. Maylath, **N. S. Wolfenbarger**, Jamin S. Greenbaum, W. Wei, S. Bo, J. Guo, T. D. van Ommen, J. L. Roberts, and D. D. Blankenship. [A New Estimate of Marine Ice Accretion Under Amery Ice Shelf](#). *AGU Fall Meeting* (2018) Poster Presentation.
  3. **N. S. Wolfenbarger**, D. D. Blankenship, K. M. Soderlund, D. A. Young, and C. Grima. [Leveraging Terrestrial Marine Ice Cores to Constrain the Composition of Ice on Europa](#). *Europa Deep Dive II: Composition* (2018) Poster Presentation.
  2. **N. S. Wolfenbarger**. [The Habitability of Icy Ocean Worlds](#). *Planetary Habitability Pop-Up Institute* (2018) Oral Presentation.
  1. **N. S. Wolfenbarger** and S. Bae. [Star tracker distortion characterization using localized attitude dependent distortion estimation methods for the ICESat mission](#). *AIAA/AAS Astrodynamics Specialist Conference* (2016) Oral Presentation.