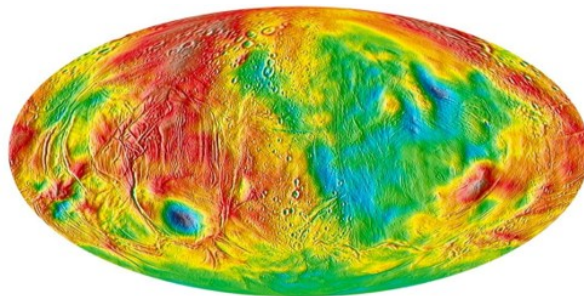


Alexander Berne

Ph.D. Candidate, NASA FINESST Fellow
California Institute of Technology, Pasadena, CA
🌐 alexcberne.com | ✉ aberne@caltech.edu | 📞 +1 772 480 7495



▲ *Global Topography Map of Enceladus*

Research Interests

Numerical modelling of planetary interior processes, including tidal dynamics, fault deformation, and thermal evolution. Space geodesy and associated applications, particularly using radar imaging and gravimetry. Bayesian methods for geophysical inverse problems.

I. Employment

Graduate Research Associate 2022 - present
Seismological Laboratory
California Institute of Technology
Supervisor: Mark Simons

Affiliate 2022 - present
NASA Jet Propulsion Laboratory
Host: Ryan Park

Graduate Research/Teaching Assistant 2020 - 2022
Division of Geological and Planetary Sciences
California Institute of Technology

Undergraduate Research/Teaching Assistant 2016 - 2019
Department of Mechanical Engineering,
University of Miami

II. Education

Ph.D. (Geophysics) at California Institute of Technology 2020 - present
Thesis: Exploring Different Scales of Crustal Deformation on Enceladus
Advisor: Associate Professor Mark Simons

M.Sc. (Physics) at Oxford University 2019 - 2020
Thesis: Characterising the Behaviour of an Energy Monitor Device for FLASH Radiation for Cancer Radiotherapy
Advisor: Associate Professor Boris Vojnovic

B.S.M.E. (Mechanical Engineering) at University of Miami 2015 - 2019
Thesis: An automatic control system for a thermo-electric ice coring drill to recover samples from Greenland's ice sheet.
Advisor: Assistant Professor Mason Klein

III. Research Grants and Fellowships Awarded

Total Amount Awarded as PI or Science PI: \$600,000

2025 - 2028 Lunar Data Analysis Program (LDAP),
Exploring the Origin of the Lunar Nearside- Farside Asymmetry using Time-Variable Gravity and Topography
Science PI: Alexander Berne
Total Award: \$450,000

2022 - 2025 Future Investigators in NASA Earth and Space Sciences (FINESST),
Exploring Different Scales of Crustal Deformation on Enceladus
FI: Alexander Berne
Total Award: \$150,000

2022 - 2024 Geomechanics and Mitigation of Geologic Hazards (GMG),
Structural Controls on Degassing Dynamics in Volcanic Systems
PI: Joann Stock
Role: Co-Investigator

2020 - 2021 Resnick Sustainability Institute
Understanding Feedback between the Biosphere and Volcanic CO2 Emissions
PI: Joann Stock
Role: Co-Investigator

IV. Honors and Awards

Total amount awarded: \$12700

2024 CIG Research Spotlight: *Modelling Crustal Deformation for Saturn's Moon Enceladus using PyLith*
2024 Travel Funds: *Adapting Pylith for Machine Learning Applications* Award: \$700
2023 Funds for CUBIT Development *Using CUBIT to study the geodynamics of planetary satellites* Award: \$4000
2023 Travel Funds: *Adapting Pylith for Multi-Physics Applications in Geophysics* Award: \$1100
2022 Travel Funds: *Adapting Pylith for Planetary Geophysics Beyond Earth* Award: \$700
2020 Distinction (for Master's Thesis), Oxford University
2019 Valedictorian of the Mechanical Engineering Program
2019 Best Senior Design Project in Mechanical Engineering
2019 Best Student Presentation, Undergraduate Student Research Day, University of Miami
2019 Einspruch Scholarship Department of Mechanical Engineering, University of Miami Award: \$3000
2019 Engineering School Valedictorian, University of Miami
2015 STEM Career Development Award Award: \$700
2015 High School Salutatorian
2014 National Merit Scholarship Award: \$2500

V. Professional Development

Activities directly related to research including workshops, mission formulation work, etc.

2021 - Present *Nightingale Enceladus Geophysical Orbiter*, PI: Mark Simons.
Nightingale is a NASA mission concept currently under development at JPL to study Enceladus's geodynamics and habitability using radar interferometry (InSAR) and other geophysical measurements.
Role: Graduate Student Member of the Science Team

2021 Keck Institute for Space Studies (KISS) "Next Generation Planetary Geodesy".

An invitation-only, week-long "think-tank" program aimed at developing new, innovative, and revolutionary mission concepts for using modern geodetic techniques to constrain processes in the interior of planetary bodies.

Team leads: James Tuttle Keane (JPL), Michael Sori (Purdue), Anton Ermakov (Berkeley).

Role: Co-author of proposal and program participant

2021 - 2024 Computational Infrastructure for Geodynamics, Pylith Hackathon and Workshop

An invitation-only, week-long workshop aimed at presenting work in computational geodynamics using Pylith. An attached hackathon involves adding functionality to the finite-element code Pylith.

Team leads: Brad Aagaard (UC Davis), Matthew Knepley (SUNY), Charles Williams (GNS Science).

Role: Participant and Presenter

2021 - Present Pylith: a Finite-Element Code for Simulations of Crustal Deformation

Development work for a finite element code capable of simulating frictional mechanics, viscoelastic rheology, and complex geometries. Pylith is principally designed to model terrestrial dynamics, but is being adapted (by me) to model crustal dynamics for bodies beyond Earth.

Team leads: Brad Aagaard (UC Davis), Matthew Knepley (SUNY), Charles Williams (GNS Science).

Role: Developer

VI. Peer-Reviewed Publications

5 first author publications
3 co-author publications, and 2 in review

Park, R.S., **Berne, A.**, Konopliv, A.S., Keane, J.T., Matsuyama, I., Nimmo, F., Rovira-Navarro, M., Panning, M., Simons, M., Stevenson, D.J., Weber, R.C., (2024). Nearside-Farside Thermal Asymmetry in the Moon's Mantle inferred from Monthly Tidal Response. (submitted, under review *Nature*)

Spitale, J., Tigges, M., **Berne, A.**, Rhoden, A., Hurford, T., and Webster, K., Curtain-Based Maps of Eruptive Activity in Enceladus' South-Polar Terrain at Fifteen Cassini Epochs. (submitted, under review *The Planetary Science Journal*)

Rovira-Navarro, M., Matsuyama, I., and **Berne, A.** "A Spectral Method to Compute the Tides of Laterally-Heterogeneous Bodies." *The Planetary Science Journal* 5.5: 129 (2024). Preprint DOI: [10.3847/PSJ/ad381f](https://doi.org/10.3847/PSJ/ad381f)

Berne, A., Simons, M., Keane, J. T., Park, R. S., and Leonard, E. J. (2024). Jet Activity at Enceladus linked to tidally-driven strike slip motion along tiger stripes. *Nature Geoscience*, vol. , pp. DOI: [10.1038/s41561-024-01418-0](https://doi.org/10.1038/s41561-024-01418-0)

Nelson, K.M., Jiménez, C., Deering, C.D., de Moor, M.J., Blackstock, J.M., Broccardo, S.P., Schwandner, F.M., Fisher, J.B., Chatterjee, S., Induni, G.A. and Rodriguez, A., ... **Berne, A.**, ... (2024). Total CO2 budget estimate and degassing dynamics for an active stratovolcano: Turrialba Volcano, Costa Rica. *Journal of Volcanology and Geothermal Research*, p.108075. DOI: <https://doi.org/10.1016/j.jvolgeores.2024.108075>

Park, R. S., Mastrodemos, N., Jacobson, R. A., **Berne, A.**, Vaughan, A. T., Hemingway, D. J., ... and Vance, S. (2024). The global shape, gravity field, and libration of Enceladus. *Journal of Geophysical Research: Planets*, 129(1), e2023JE008054. DOI: <https://doi.org/10.1029/2023JE008054>

Berne, A., Simons, M., Keane, J. T., and Park, R. S. (2023). Using Tidally-Driven Elastic Strains to Infer Regional Variations in Crustal Thickness at Enceladus. *Geophysical Research Letters*, 50(22), e2023GL106656. DOI: <https://doi.org/10.1029/2023GL106656>

Berne, A., Simons, M., Keane, J. T., and Park, R. S. (2023). Inferring the mean thickness of the outer ice shell of Enceladus from diurnal crustal deformation. *Journal of Geophysical Research: Planets*, 128(6), e2022JE007712.

DOI: [10.1029/2022JE007712](https://doi.org/10.1029/2022JE007712)

Berne, A., Zhang, T., Shomar, J., Ferrer, A. J., Valdes, A., Ohyama, T., and Klein, M. (2023). Mechanical vibration patterns elicit behavioral transitions and habituation in crawling *Drosophila* larvae. *Elife*, 12, e69205. DOI: <https://doi.org/10.7554/eLife.69205>

Berne, A., Petersson, K., Tullis, I. D., Newman, R. G., and Vojnovic, B. (2021). Monitoring electron energies during FLASH irradiations. *Physics in Medicine and Biology*, 66(4), 045015. DOI: [10.1088/1361-6560/abd672](https://doi.org/10.1088/1361-6560/abd672)

VII. Invited Presentations, Seminars, and Colloquia

9 invited presentations

2024 California Institute of Technology: DIX Planetary Science Seminar, *Enceladus Spills its Guts: A Relationship Between Strike-Slip Motion and Jet Activity over the Tiger Stripes*

2024 California Institute of Technology Seismological Laboratory: Graduate Student Seminar *Exploring a Relationship Between Fault Motion and Jet Activity over Saturn's moon Enceladus*

2023 Jet Propulsion Laboratory: Planetary Science Seminar, *Using Multi-Scale Surface Strain and Gravity Measurements to Infer Regional Variations in Crustal Thickness at Enceladus*

2023 Dartmouth University: Ice + Climate Seminar, *Strike-Slip Motion Along Frictional Tiger Stripes May Regulate Jet Activity at Enceladus*

2023 California Institute of Technology Seismological Laboratory: Graduate Student Seminar *Exploring Different Scales of Diurnal Crustal Deformation on Enceladus*

2022 California Institute of Technology: Yuk Yung Lunch Seminar, *Modelling the Spatiotemporal Dependence of Diurnal Tidal Deformation Patterns on Regional Crustal Structure at Enceladus*

2022 Resnick Sustainability Institute: Weekly Seminar, *CO₂ Ground Flux Inversions from Airborne Concentration Data at Rincon de la Vieja Volcano, Costa Rica*

2022 Pylith Workshop: Invited Presentation, *Modelling Planetary Geodynamics with Pylith*

2022 California Institute of Technology Seismological Laboratory: Graduate Student Seminar *Exploring a Relationship Between Fault Motion and Jet Activity over Saturn's moon Enceladus*

VIII. Conference Presentations

7 first author conference proceedings and 8 co-author conference proceedings

- 2024 Bagheri, A.B., Vance, D., **Berne A.**, Castillo-Rogez, J.C., Keane, J.T., Leonard, E.J., Mitchell, K., Park, R.S., and Simons, M., 2024. Assessing the Habitability of Enceladus with a Suite of Geophysical Investigations. AbSciCon
- 2024 Bagheri, A.B., Journaux, B.J., **Berne A.**, and Simons, M.S., 2024. Tidal Constraints on the Properties of Enceladus's Subsurface Ocean. LPI Contributions, 3040, p.2792.
- 2023 **Berne A.**, Simons, M., Keane, J.T. and Park, R.S., 2023. Strike-Slip Motion Along Frictional Tiger Stripes May Modulate Jet Activity at Enceladus. AGU23.
- 2023 Simons M, Anderson B, Benedikter A, Bhaskaran S, **Berne A.**, Horst S, Hurst K, Jones D, Keane J, Krieger G, Leonard E. Crustal deformation derived from repeat-pass Interferometric SAR at Enceladus—why and how?. InAAS/Division for Planetary Sciences Meeting Abstracts 2023 Oct (Vol. 55, No. 8, pp. 210-07).
- 2023 **Berne A.**, Simons M, Keane J, Park R. Using Tidally Driven Elastic Strains to Infer Regional Crustal Thickness at Enceladus. LPI Contributions. 2023 May;2992:6009.
- 2023 Vance S, Castillo-Rogez J, **Berne A.**, Hendrix A, Keane J, Leonard E, Mitchell K, Nimmo F, Park R, Simons M. Does Enceladus Have an Active Core with Hydrothermal Circulation?. InAAS/Division for Planetary Sciences Meeting Abstracts 2023 Oct (Vol. 55, No. 8, pp. 509-08).
- 2023 Rovira-Navarro, Marc, Isamu Matsuyama, and **Berne A.**, "Revealing lateral structures in the interiors of planets and moons from tidal observations." AGU23 (2023).
- 2023 Tam R, **Berne A.**, Köhne T, Simons M. Inferring Crustal Thickness for Enceladus from Tidal Strain Fields Through Multi-Scale Inversion. AGU23. 2023 Dec 14.
- 2022 Keane, J.T., Sori, M.M., Ermakov, A.I., Austin, A., Bapst, J., **Berne A.**, Bierson, C.J., Bills, B.G., Boening, C., Bramson, A.M. and D'Amico, S., 2022, March. Next-Generation Planetary Geodesy: Results from the 2021 Keck Institute for Space Studies Workshops. In 53rd Lunar and Planetary Science Conference (Vol. 2678, p. 1622).
- 2022 **Berne A.**, Simons, M., Keane, J. T., and Park, R. S. (2022, December). Modelling the Spatiotemporal Dependence of Diurnal Tidal Deformation Patterns on Regional Crustal Structure at Enceladus. In AGU Fall Meeting Abstracts (Vol. 2022, pp. P32A-05).
- 2022 **Berne A.**, Chung, N., Stock, J. M., and Schwandner, F. M. (2022, December). An Inverse Approach to UAV-based Ground Gas Flux Monitoring at Volcanic Systems. In AGU Fall Meeting Abstracts (Vol. 2022, pp. NS24A-06).
- 2022 Nelson K, Jiménez C, Deering CD, de Moor MJ, Blackstock JM, Broccardo SP, Schwandner FM, Fisher J, **Berne A.**, Prada Cordero C, Anderson ME. Improving the Total CO2 Budget Estimate for an Active Stratovolcano in Costa Rica. InAGU Fall Meeting Abstracts 2022 Dec (Vol. 2022, pp. EP55B-06).
- 2022 **Berne A.**, Simons, M., Keane, J. T., and Park, R. S. (2022). Exploring Different Scales of Crustal Deformation at Enceladus. Outer Planets Assessment Group (OPAG).
- 2021 **Berne A.**, Simons, M., Keane, J.T. and Park, R.S., 2021, December. Modelling Tidally-Driven Crustal Dynamics of Enceladus. In AGU Fall Meeting 2021. AGU.

2019 Berne A., Zhang T, Ferrer A, Shomar J, Oyhama T, Klein M. Behavioral pattern transitions and habituation to pulsed mechanical vibration in crawling *Drosophila* larvae. In APS March Meeting Abstracts 2019 (Vol. 2019, pp. A65-009).

IX. Technical Reports and Other Publications

Sori, M., Keane, J.T. and Ermakov, A. and **Berne, A.**, and Bierson, C., and Bills, B., and Boening, C., and Bramson, A., and D'Amico, S., and Denton, C.A. and Evans, A., and Hemingway, D., and Hernandez, s., and Hostrom, K., and Izquierdo, K., and James, P. and Johnson, B., and Lau, H., and Navarro, T. 2023. Next Generation Planetary Geodesy. *Keck Institute for Space Studies*. <https://doi.org/10.7907/y1m4-ek67>.

X. Additional Scholarships

Total Amount Awarded: \$190,500

2019 - 2020 Philip and Patricia Frost Scholarship, Oxford University
Total Award: \$50,000

2015 - 2019 President's Scholarship, University of Miami
Total Award: \$140,500

XI. Selected Press Releases and News Articles

Press releases and news articles either about my research, outreach, and/or broader engagement

2024 How 'tiger stripes' on Saturn's moon Enceladus point to habitability: Study, Leah Sarnoff, *ABC News*, April 30, 2024

2024 Strike-Slip Faults Could Drive Enceladus's Jets, Kimberly Cartier, *Eos*, April 29, 2024

2024 'Tiger stripes' on Saturn's moon Enceladus could reveal if its oceans are habitable, Robert Lea, *Space.com*, April 29, 2024

2024 Enceladus Spills Its Guts through Strike-Slip Motion, Lori Dajose, *Caltech News*, April 29, 2024

2019 Student Profile: Alexander Berne, Matthew Perez, *University of Miami COE News*, March 08, 2019

2019 In Search of Hidden Worlds, Ashley Williams, *News at the U*, March 05, 2019

XII. Professional Activities and Service

2023 - present Grant Proposal Reviewer: NASA Cassini Data Analysis Program (CDAP)

2022 - present Reviewer for Publications: *Journal of Geophysical Research: Planets (JGR)*, *Global and Planetary Change (GLOPCHA)*

2024 - present Jet Propulsion Laboratory Moons, Geology and Geophysics (moons-gg) Meeting: Informal weekly meeting of scientists at JPL to discuss the geodynamics of moons in the solar system.

Role: Participant

2022 - present Caltech Center for Inclusion and Diversity: Organization to enhance the experience of all Caltech community members holistically through education, advocacy, cultural exchange, leadership development, and coalition building.

Role: Volunteer

2022 - present Ocean Worlds Colloquia: Weekly meeting of graduate students and postdocs in Caltech's Division of Geological and Planetary Sciences to discuss ocean world science.

Role: Founder

2023 - 2024 Seismolab Retreat Committee: Committee of students in Caltech's seismological laboratory (i.e., geophysics department) which organize a yearly retreat for the Seismological Laboratory

Role: Organizer

2022 - 2023 Seismolab Seminar Committee: Committee of students in Caltech's seismological laboratory (i.e., geophysics department) which organize the weekly department seminar

Role: Organizer

2022 - 2023 Seismolab Social Hour Committee: Committee of students in Caltech's seismological laboratory (i.e., geophysics department) which organize the weekly social hour (i.e., informal get-together of students).

Role: Organizer

XIII. Professional Affiliations

2023 - present American Astronomical Society (AAS), Member

2023 - present AAS Division for Planetary Sciences (DPS), Member

2022 - present Caltech Geomechanics and Mitigation of Geologic Hazards (GMG), Member

2021 - present Keck Institute for Space Studies (KISS), Workshop Participant

2020 - present American Geophysical Union (AGU), Member

XIV. Teaching Experience

2023 Graduate SURF (Summer Undergraduate Research Fellowship) Mentor (Caltech)

Project: *Inferring Crustal Thickness for Enceladus from Strain Fields Through Multi-Scale Inversion*

Role: Supervised Research Project for Riley Tam

2023 Graduate VURP (Visiting Undergraduate Research Program) Mentor (Caltech)

Project: *Developing High-throughput Gas Measurement Systems for Monitoring Volcanic Activity*

Role: Supervised Research Project for Kayleigh Fischer

2022 Graduate SURF (Summer Undergraduate Research Fellowship) Mentor (Caltech)

Project: *Developing Cost-Effective CO₂ Fluxmeters for Volcanic Gas Monitoring*

Role: Supervised Research Project for Norman Chung

2021 - 2025 Graduate Teaching Assistant (Caltech)

Ge111b: Applied Geophysics Field Course (Mark Simons)

Ge16: Earthquakes (Joann Stock)

2017 - 2019 Undergraduate Teaching Assistant (University of Miami)

MAE301: Engineering Materials Science (Ryan Karkkainen)

PHY201: University Physics I for the Sciences (Mason Klein)

XV. Public Outreach

2024 NZ Enrichment Trip, Caltech Seismological Laboratory

Role: Planned 2024 Enrichment Trip to New Zealand's North Island

2023 - present Earthquake (EQ) Fellows Program, Caltech Seismological Laboratory

Summer camp program through Caltech's Seismolab to engage High School Students in Pasadena with Geosciences.

Role: Counselor and Mentor, Occasional Speaker during daily events

2023 - present Caltech Center for Inclusion and Diversity

Role: Recurring Speaker to Discuss STEM careers with public High School students in Los Angeles

2023 - present Universe Today Podcast:

Podcast hosted by Fraser Cain (Based in Vancouver, BC) on Space News and Current Events

Role: Recurring Guest

2022 - present Pasadena Activities League (PAL) Middle School Tutoring Program

Role: Weekly hour-long tutoring of public Middle School students in Math and Physics

2019 - 2020 University of Oxford Medical Sciences Department

Program at the University of Oxford to develop the Oxford-AstraZeneca vaccine against COVID-19

Role: Volunteer lab chemist (i.e., performed routine tasks to free up time for scientists who were *really* developing a COVID vaccine).

2019 Astronomy Club, University of Miami

Role: Planned a trip with 7 participants in 2019 to view a total solar eclipse in Coquimbo, Chile

2018 Astronomy Club, University of Miami

Role: Planned a trip with 14 participants in 2018 to view the Aurora Borealis in Akureyri, Iceland

2017 Astronomy Club, University of Miami

Role: Planned a trip with 5 participants in 2017 to view the total solar eclipse in South Carolina

2017 - 2019 Scuba Diving Club, University of Miami

Role: Participant and Organizer

2016 - 2019 Astronomy Club, University of Miami

Role: Founder, President, and Skywatcher (i.e., trip organizer)

2016 - 2017 Exoplanet Hunting Society, University of Miami

Club dedicated to detecting exoplanets using amateur telescopes and equipment (i.e., CCD cameras). We successfully measured ~12 transit curves!

Role: Founder and President

2018 - 2019 Frost Science Museum, Miami Florida

With other members of the University of Miami Astronomy club, organized two public "telescope viewing" events for members of the general public.

Real quote from one participant: "Saturn's Rings are much prettier in real life"

Role: Organizer

2018 - 2019 Fox Observatory Amateur Astronomers, Weston Florida
With other members of the University of Miami Astronomy club, organized several public "telescope viewing" using the Fox observatory telescopes in Markham Park, Florida
Role: Organizer

2014 Bishop Gorman Dominican Republic Volunteers
A community service organization based in the Dominican Republic that seeks to work with Haitian refugees to improve their health and well-being
Role: Volunteer Translator and Shelter Builder

2013 - present Pasadena Radio Club American Radio Relay League
Extra HAM radio operator (KE5VYT), currently involved in emergency response volunteering efforts through the Pasadena Radio Club
Role: Volunteer

2012 - 2013 St. Vincent de Paul Food Bank
A community service organization aimed at delivering food to marginalized communities in Tyler, Texas
Role: Volunteer

2011 - 2013 Tyler Humane Society
A humane shelter in Tyler, Texas for abandoned pets.
Role: Volunteer

XVI. References

Mark Simons

Professor, Division of Geological and Planetary Sciences,
California Institute of Technology
E-mail: simons@caltech.edu
Phone: (626) 395-6984

Isamu Matsuyama

Professor, Lunar and Planetary Laboratory
University of Arizona
E-mail: isa@lpl.arizona.edu
Phone: (520) 621-4002

James Tuttle Keane

Scientist: NASA Jet Propulsion Laboratory (JPL).
E-mail: james.t.keane@jpl.nasa.gov
Phone: (818) 354-9036

Ryan Park

Senior Research Scientist and Principal Engineer
NASA Jet Propulsion Laboratory (JPL).
E-mail: ryan.s.park@jpl.nasa.gov
Phone: (818) 354-4401

Michael Gurnis

Director and Professor, Siesmological Laboratory
E-mail: gurnis@caltech.edu
Phone: (626) 395-6979