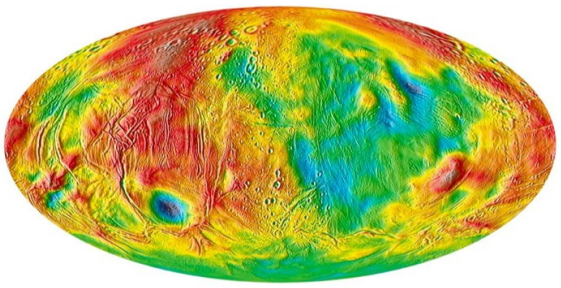
Alexander Berne

Ph.D. Candidate, NASA FINESST Fellow
California Institute of Technology
Seismological Laboratory, Pasadena, CA 91125 USA
alexcberne.com | aberne@caltech.edu | tel:+1 772 480 7495



Topography map of Enceladus derived from Cassini stereo-imagery (see my publications)

Research Interests

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

I. Employment

2022 - present Affiliate for Science, Research, and Technology Devepment Initiative, NASA Jet Propulsion Laboratory.
Host: Ryan Park

2022 - present Graduate Research Associate: Division of Geological and Planetary Sciences, California Institute of Technology.

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

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

2017- 2017 Electrical Engineering Intern, Florida Power and Light.

II. Education

2020 - 2025 PhD (Geophysics) at **California Institute of Technology**
Thesis: Exploring Different Scales of Crustal Deformation on Enceladus
Advisor: Associate Professor Mark Simons

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

2015 - 2019 BS (Mechanical Engineering) at **University of Miami** (Valedictorian)
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 Lead Investigator: $150,000

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

2022 - 2024 Geomechanics and Mitigation of Geologic Hazards, *Structural Controls on Degassing Dynamics in Volcanic Systems*
PI: Joann Stock

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

IV. 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.
Role: Participant and Presenter

2021 - Present *Pylith: a Finite-Element Code for Simulations of Crustal Deformation*
Development work for a 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.
Role: Participant and Presenter

V. Honors and Awards

Total amount awarded: $12700

2024 Travel Stipend Award: *Adapting Pylith for Machine Learning Applications* *Award:* $700
2023 CUBIT Development Award *Using CUBIT to study the geodynamics of planetary satellites* *Award:* $4000
2023 Travel Stipend Award: *Adapting Pylith for Multi-Physics Applications in Geophysics* *Award:* $1100
2022 Travel Stipend Award: *Adapting Pylith for Planetary Geophysics Beyond Earth* *Award:* $700
2020 Distinction (for Master's Thesis), Oxford University
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

VI. Peer-Reviewed Publications

5 first author publications, and 2 in preparation
2 co-author publications, and 1 in review, and 2 in preparation

Berne, A., Simons, M., Keane, J., and Park, R., Constraints on Ice Shell Structure from the Spectral Localization of Surface Topography at Enceladus (in prep)

Berne, A., Nelson, K., Chung, N., and Stock, J., An Inverse Approach to Monitor Volcanic CO2 Flux using Unmanned Aerial Vehicles at Rincon de la Vieja Volcano, Costa Rica (in prep)

Bhageri, A., Simons, M., **Berne, A.**, Vance, S., On the Detectability of the Interior Properties of Enceladus using Tidal Measurements (in prep)

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. (in prep)

Rovira-Navarro, M., Matsuyama, I., and **Berne, A.** "A Spectral Method to Compute the Tides of Laterally-Heterogeneous Bodies." *arXiv preprint* (2023). Preprint DOI: 10.48550/arXiv.2311.15710 (accepted at PSJ)

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

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

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

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 Seimological 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 Seimological 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, *CO_2 Ground Flux Inversions from Airborne Concentration Data at Rincon de la Vieja Volcano, Costa Rica*

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

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

VIII. 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.

IX. 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

X. Conference Presentations

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

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).

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. InAPS March Meeting Abstracts 2019 (Vol. 2019, pp. A65-009).

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