

Grace Carlson, Ph.D.

Postdoctoral Researcher at University of California, Berkeley

Email: gacarlson@berkeley.edu; Phone: +1 (317)-306-9571

Research Interests

Remote sensing for water resource management; Solid Earth response to changes in terrestrial hydrology; groundwater hydrology; subsidence monitoring; drought monitoring; inverse methods; data fusion.

Education

Virginia Tech, Blacksburg, VA

Jan. 2021-

Dec. 2022

Ph.D. in Geosciences

Dissertation title: Remote Sensing of 21st Century Water Stress for Hazard Monitoring in California.

Advisor: Dr. Manoochehr Shirzaei

Arizona State University, Tempe, AZ

Aug. 2017-

Dec. 2020

M.S. in Geological Sciences

Topic: Aquifer volume strain and associated hazards in the San Joaquin Valley, California, and central Arizona.

Advisor: Dr. Manoochehr Shirzaei

Indiana University, Bloomington, IN

Aug. 2013-

May 2017

B.S. in Geological Sciences

Minors: Math, Physics, Political Science

Senior thesis title: Spatially varying stress state in the central U.S. from joint inversion of focal mechanism and maximum horizontal stress data.

Advisor: Dr. Kaj Johnson

Work Experience

Postdoctoral Researcher

Feb. 2023 -

Present

University of California, Berkeley, Department of Environmental Science, Policy, and Management

Graduate Research Assistant

Jan. 2021 - Dec.

2022

Virginia Tech, Department of Geosciences

Graduate Research Assistant

Aug. 2017 - Dec.

2020

Arizona State University, School of Earth and Space Exploration

Undergraduate Research Assistant

Sept. 2015 - May

2017

Indiana University Department of Earth and Atmospheric Science

Math and Physics Tutor
2017
Indiana University, Athletic Department

Oct. 2016 – Aug

Math Tutor
2017
Ivy Tech Community College, Bloomington, IN

May 2017 – Aug

Publications

Manuscripts in Preparation

- **Carlson G.**, Werth, S., Giroto, M. (202?), Drought propagation characteristics in The Sacramento-San Joaquin- Tulare River Basins, manuscript in prep.

Manuscripts Under Review

- **Carlson, G.**, Massari, C., Rotiroti, Bonomi, T., M., Preziosi, E., Wilder, A., Whitaker, D., Giroto, M. (202?), Intensive Irrigation buffers groundwater declines in key European breadbasket, *Nature Water*, in review.
- Werth, S., Shirzaei, M., **Carlson, G.**, Bürgmann, R. (202?), Bridging Central Valley Deep Aquifer Recharge and High Sierra Nevada Snowpack, *Water Resources Research*, in review.

Peer Reviewed Publications

- **Carlson, G.**, Werth, S., Shirzaei, M. (2024), A Novel Hybrid GNSS, GRACE, and InSAR Joint Inversion Approach to Constrain Water Loss During a Record-Setting Drought in California, *Remote Sensing of Environment*, 311, 114303, <https://doi.org/10.1016/j.rse.2024.114303>.
- Khorrami, M., Shirzaei, M., Ghobadi-Far, K., Werth, S., **Carlson, G.**, & Zhai, G. (2023), Groundwater volume loss in Mexico City constrained by InSAR and GRACE observations and mechanical models, *Geophysical Research Letters*, 50, e2022GL101962. <https://doi.org/10.1029/2022GL101962>.
- **Carlson, G.**, Werth, S., Shirzaei, M. (2022), Joint Inversion of GNSS and GRACE for Terrestrial Water Storage Change in California, *Journal of Geophysical Research: Solid Earth*, <http://doi.org/10.1029/2021JB023135>.
- Shirzaei, M., Khoshmanesh, M., Ojha, C., Werth, S., Kerner, H., **Carlson, G.**, Futi Sherpa, S., Zhai, G., Lee, J.C. (2021), Persistent impact of spring floods on crop loss in U.S. Midwest, *Weather and Climate Extremes*, Volume 34, 100392, ISSN 2212-0947, <https://doi.org/10.1016/j.wace.2021.100392>.
- **Carlson, G.**, Shirzaei, M., Ojha, C., & Werth, S. (2020), Subsidence-derived volumetric strain models for mapping extensional fissures and constraining rock mechanical properties in the San Joaquin Valley, California, *Journal of Geophysical Research: Solid Earth*, 125, <https://doi.org/10.1029/2020JB019980>.
- **Carlson, G.**, Shirzaei, M., Zhai, G., Werth, S., & Ojha, C. (2020), Seasonal and Long-term Groundwater Unloading in the Central Valley Modifies Crustal Stress, *Journal of Geophysical Research: Solid Earth*, <https://doi.org/10.1029/2019JB018490>.
- **Carlson, G.**, Carnes, L., & Cook, J. (2019), Exploring Arizona earth fissures: An anthropogenic geologic hazard in Pearthree, P. *Field Guide 55: Geologic Excursions in Southwestern North America*.
- Shirzaei, M., Ojha, C., Werth, S., **Carlson, G.**, & Vivoni, E. (2019), Comment on “Short-lived pause in Central California subsidence after heavy winter precipitation of 2017” by K. D. Murray and R. B. Lohman, *Science Advances*, DOI: 10.1126/sciadv.aav8038.

- **Carlson, G.**, Johnson, K., Chuang, R., & Rupp, J. (2018), Spatially varying stress state in the central U.S. from Bayesian inversion of focal mechanism and in situ maximum horizontal stress orientation data, *Journal of Geophysical Research: Solid Earth*, 123, <https://doi.org/10.1002/2017JB015158>.
- Rupp, J.A., Letsinger, S., **Carlson, G.** (2018), Fault Control on Potential Seismic Slip in the Illinois Basin Region, *Seismological Research Letters*, doi: 10.1785/0220180153.
- Yanites, B.J., Mitchell, N.A., Bregy, J.C., **Carlson, G.A.**, Cataldo, K., Holahan, M., Johnston, G.H., Nelson, A., Valenza, J., Wanker, M. (2018), Landslides control the spatial and temporal variation of channel width in southern Taiwan: implications for landscape evolution and cascading hazards in steep, tectonically active landscapes, *Earth Surface Processes and Landforms*, <https://doi.org/10.1002/esp.4353>.
- Lahann, R. L., Rupp, J. A., Medina, C. R., **Carlson, G.**, and Johnson, K. M. (2017), State of Stress in the Illinois Basin and Constraints on Inducing Failure, *AAPG Environmental Geosciences*, 24(3), <https://doi.org/10.1306/eg.0206171600817004>.

Select Presentations

Invited Talks

- **Carlson, G.**, Werth, S., & Shirzaei, M. (September 2024), Measuring drought impacts using GNSS, InSAR, and GRACE, Earthscope Webinar, Virtual
- **Carlson, G.**, Werth, S., & Shirzaei, M. (June 2024), Measuring drought impacts using GNSS, InSAR, and GRACE, SAGE/GAGE Community Science Workshop, Virtual
- **Carlson, G.**, Shirzaei, M., Werth, S., & Khorrami, M. (June 2024), Identification and Separation of Hydrologic Signatures in Geodetic Datasets, Crustal Deformation Modeling Workshop, Golden, CO
- **Carlson, G.**, Shirzaei, M., & Werth, S. (February 2024), Remote Sensing of 21st Century Groundwater Stress, University of California, Davis, Department of Earth and Planetary Science, Davis, CA
- **Carlson, G.** (January 2024), Remote Sensing of 21st Century Groundwater Stress, Indiana University, Department of Geography, Bloomington, IN
- **Carlson, G.**, Shirzaei, M., Werth, S., & Ojha, C. (June 2022), Water Loss and Associated Deformation Across California From 2003 to 2021, NASA Jet Propulsion Laboratory, Virtual
- Invited panelist, Education Panel at the 2021 Prison Education Conference, Arizona State University

Conference presentations

- **Carlson, G.**, Massari, C., Rotiroti, M., Preziosi, E., Bonomi, T., Wilder, A., Werth, S., Whitaker, D., Wang, T., Cowherd, M., and Giroto, M. (2024), Groundwater storage trends in northern Italy as observed by GRACE, well measurements, and vertical land motion, 2024 European Geophysical Union Meeting, Vienna, Austria.
- **Carlson, G.** & Giroto, M. (2023), The relationship between Sierra Nevada snowpack and Central Valley groundwater during multi-year droughts: A multivariate probabilistic analysis, 2023 American Geophysical Union Meeting, San Francisco, CA.
- **Carlson, G.**, Wilder, A., Massari, C., Werth, S., Whitaker, D., Wang, T., Cowherd, M., Giroto, M., Accelerated groundwater loss in northern Italy as observed by GRACE, well measurements, and vertical land motion, GRACE-FO Science Team Meeting, Boulder, CA.
- **Carlson, G.**, Taira, T., Shirzaei, M. (2022), Periodic Seismic Velocity Changes in Southern California Caused by Changes in Seasonal Stress, 2022 American Geophysical Meeting, Chicago, IL.
- **Carlson, G.**, Shirzaei, M., & Werth, S. (2022), Mapping Water Storage Loss During the Most Recent California Drought Using InSAR, GNSS, and GRACE-FO, 2022 American Geophysical Meeting, Chicago, IL.

- **Carlson, G.**, Werth, S., Shirzaei, M. (2022), Improving groundwater loss estimates using a combination of GNSS, GRACE-FO, and InSAR: Case study of California’s recent 2020-2021 drought, GRACE-FO Science Team Meeting, Potsdam, Germany.
 - **Carlson, G.**, Shirzaei, M., Werth, S. (2021), Improved spatiotemporal resolution of terrestrial water storage change in California through joint inversion of GNSS and GRACE observations, 2021 American Geophysical Meeting, New Orleans, LA.
 - **Carlson, G.**, Werth, S., Shirzaei, M. (2021), 14 Years of Monthly TWS fluctuations in California Using a Joint Inversion of GNSS and GRACE, GRACE-FO Science Team Meeting, virtual.
 - **Carlson, G.**, Shirzaei, M., Ojha, C., Miller, M., & Werth, S. (2020), Subsidence-Derived Aquifer Volume Strain Models for the San Joaquin Valley, California and Central Arizona, 2020 American Geophysical Meeting, virtual.
 - **Carlson, G.**, Shirzaei, M., Werth, S., Zhai, G., & Ojha, C. (2019), Integrating Groundwater Storage Change into Terrestrial Water Storage Change Estimates and Crustal Stress Change Calculations in California Using InSAR, GPS, and GRACE, 2019 American Geophysical Union Fall meeting, San Francisco, CA, USA.
 - **Carlson, G.**, Shirzaei, M., Werth, S., Zhai, G., & Ojha, C. (2019). How we use deformation data above large aquifer systems to understand climatic and anthropologically driven stress and seismicity fluctuations in California, 2019 American Geophysical Union Fall meeting, San Francisco, CA, USA.
 - **Carlson, G.**, Werth, S., Shirzaei, M., (2019). Towards Integrated TWS variation from a combination of GRACE, GPS, and InSAR: Implications for Hydro-Tectonic Studies, Abstract, GRACE Science Team Meeting, Pasadena, CA, USA, October 9, 2019.
 - **Carlson, G.**, Carnes, L., Walker, I., Arrowsmith, R., Turner, C., Feary, D., Gootee, B., Leonard, J. and Cook, J. (2019), Monitoring Anthropogenic Earth Fissure Hazards in Arizona with UAS-SFM, the Annual Meeting, GSA, Phoenix, AZ, USA, Sept. 25, 2019.
 - **Carlson, G.**, Shirzaei, M., Ojha, C., & Werth, S. (2018), The Effect of Aquifer Compaction and Groundwater Unloading on Crustal Stress Change in California During the 2007-2010 Drought, 2018 American Geophysical Union Fall meeting, AGU, Washington D.C., USA, Dec. 13, 2018.
- *Outstanding Student Presentation Award**

Funding

+ *Indicates that authors contributed equally*

Funded Proposals

National Research Council of Italy Short Term Mobility Program. **Grace Carlson**⁺, Christian Massari⁺, *Groundwater storage trends over the Northern Italian Plains from 2003-2023 using remote sensing and in-situ observations*
2024

Oct. 2024-Nov.

NASA ROSES. Manuela Girotto (PI), Susanna Werth (co-I), Erica Siirila-Woodburn (co-I), **Grace Carlson** (Postdoctoral Associate), Manoochehr Shirzaei (collaborator). *The Role of Sierra Nevada Mountains in Regulating Central Valley Groundwater Recharge*
2027

2024-

NASA FINESST. **Grace Carlson** (FI), Manoochehr Shirzaei (PI). *Exploring the relationship between hydrologic loading and fault creep: a case study on the Salton Sea and southern San Andreas Fault*

2020-2024

Scholarships

- School of Earth and Space Exploration First Year Fellowship, 2017
- IUGFS Class of 2013 Katharine E. Compton Memorial Scholarship, 2016
- Hutton International Experience Program Scholarship, 2015
- IU Excellence Scholarship, 2013
- IU Arts and Sciences Indiana Scholars Scholarship, 2013

Awards and Honors

- ASU College of Arts and Sciences Student Leader, nominated by faculty, 2019 and 2020
- ASU College of Arts and Sciences Graduate Excellence Award, 2019
- Outstanding Student Presentation Award, Geodesy Section, 2018 AGU Fall Meeting
- School of Earth and Space Exploration First Year Award, 2017
- IU Department of Earth and Atmospheric Sciences Professional Development Award, 2017

Outreach and Service Activities

- Working Group 3.1 vice-chair, International Association of Geodesy, Commission 3.1, 2024-2026
- Representative member, Inter-Commission Committee on Geodesy for Climate Research, 2023-2027
- Founder and Lead Teacher, Prison Education Program in the School of Earth and Space Exploration, Jan. 2019-May 2022
- Facilitator for Inclusion, leading Bystander Intervention for Harassment Prevention Workshops for the College of Liberal Arts and Sciences at Arizona State University, Apr. 2020-May 2022
- Co-leader for GSA Field Trip #408: Exploring Arizona Earth Fissures, GSA Annual Meeting 2019, Phoenix, AZ.
- Vice President, School of Earth and Space Exploration Graduate Student Council at Arizona State University, Aug. 2019-Aug. 2020
- Elected Member, School of Earth and Space Exploration Graduate Student Council at Arizona State University, Aug. 2018-Aug. 2019

Teaching and Mentoring Experience

- Mentor for the Tuskegee-Spelman-Berkeley Summer Research Program, summer 2023.
- Introduction to Exploration: Earth, Planets, and Stars. Online course developed for Arizona Department of Corrections.
- Introduction to Exploration: Earth, Planets, and Stars. Co-teacher in Eyman State Prison in Florence, AZ, Spring 2019, Fall 2019, Winter 2020 (in-person).