

# Ryan A. Green

MARINE CARBON DIOXIDE REMOVAL · BIOGEOCHEMICAL MODELING · CHEMICAL OCEANOGRAPHY

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## Summary

I advance marine carbon dioxide removal (mCDR) by integrating oceanographic modeling (ROMS) with comprehensive measurement evaluation. Through high-resolution simulations of the California Current System, I assess the potential of ocean alkalinity enhancement and direct ocean capture across varied deployment locations, identifying optimal strategies for CDR. With expertise in carbonate chemistry and marine carbon cycling, I have evaluated a range of measurement tools—from carbonate parameters to isotopic tracers—for monitoring and verifying mCDR interventions. I apply this knowledge in both academic research and scientific consulting to support the successful implementation of mCDR technologies.

## Education

### University of California, Santa Cruz

Santa Cruz, CA

PHD EARTH AND OCEAN SCIENCES

2019 - 2025

- Dissertation: "Carbon Isotopes as Tools for Understanding Natural and Engineered Ocean Alkalinity Enhancement"

### University of California, Davis

Davis, CA

BS ENVIRONMENTAL POLICY

2013 - 2018

- Minor in Oceanography
- Graduated with honors & a departmental citation

## Research Experience

### University of California Santa Cruz - Dept of Earth and Planetary Sciences

Santa Cruz, CA

CO-ADVISORS: DR. MATHIS P. HAIN, DR. PATRICK A. RAFTER

2019 - 2025

- Developed and applied a coupled regional-global carbon cycle model to study geologic analogs of Ocean Alkalinity Enhancement (OAE) in the Eastern Tropical North Pacific.
- Evaluated the use of carbon isotopes as tools for monitoring, reporting, and verification (MRV) in marine carbon dioxide removal (mCDR) projects.
- Simulated a range of OAE and direct ocean capture deployment scenarios within the California Current System using the Regional Ocean Modeling System (ROMS).

### University of New South Wales - Climate Change Research Centre

Sydney, NSW

CO-ADVISORS: DR. LAURIE MENVIEL, DR. KATRIN J. MEISSNER

2018-2019

- Analyzed seasonal sea-ice cover at the Last Glacial Maximum (LGM). Determined the most likely summer and winter sea-ice edge at the LGM and constrained the mechanisms controlling sea ice in different Earth System Models.

### University of California, Davis - Dept of Evolution and Ecology

Davis, CA

SUPERVISOR: DR. NICOLE M. KOLLARS

2018

- Assisted in various laboratory techniques, including DNA extraction, polymerase chain reaction, gel electrophoresis, and spectroscopy to investigate the genetic composition of the seagrass species.

### University of California, Davis - Dept of Environmental Science and Policy

Davis, CA

SUPERVISOR: DR. LAUREN YAMANE

2017

- Gathered fish life history data from surveys around the Channel Islands of California. Analyzed and identified key species characteristics, contributing to the development of models that predict species response to Marine Protected Areas (MPAs).

## Professional Experience

### Oceanid MRV / Oceanid Climate and Carbon Solutions

OCEANOGRAPHY CONSULTANT

June 2023 - present

- Providing scientific expertise on ocean carbon cycling and carbonate chemistry
- Helping develop monitoring, reporting, and verification (MRV) frameworks for different marine carbon dioxide removal (mCDR) pathways

## Publications

### PUBLISHED

**Green, R. A.,** Menviel, L., Meissner, K. J., Crosta, X., Chandan, D., Lohmann, G., Peltier, W. R., Shi, X., and Zhu, J. 2022. Evaluating seasonal sea-ice cover over the Southern Ocean at the Last Glacial Maximum. *Climate of the Past*, 2(1): 1000-1100.

**Green, R. A.,** Hain, M. P., & Rafter, P. A. (2024). Deglacial pulse of neutralized carbon from the Pacific seafloor: A natural analog for ocean alkalinity enhancement? *Geophysical Research Letters*, 51, e2024GL108271. <https://doi.org/10.1029/2024GL108271>.

Kitch, G. D., Duke, P. J., Grabb, K. C., Simancas-Giraldo, S., Adekunbi, F. O., Addey, C. I., Arbilla, L. A., Carvalho, A. C. O., Chu, S. N., **Green, R. A.,** Hamnca, S., Ghosh, A., Kirkland, A., Lowder, K. B., Meléndez, M., Fontela, M., Robache, K., Ringham, M. C., Rønning, J., Schockman, K. M., Stoll, M. M., Oliveira, R. R., and Wright-Fairbanks, E. K. 2025. Early career recommendations for the equitable growth of a marine carbon dioxide removal sector, *Perspectives of Earth and Space Scientists*, 6, e2024CN000246. <https://doi.org/10.1029/2024CN000246>

## SUBMITTED

**Green, R. A.,** Rafter, P. A., Sun, C., Gray, W. R., Rae, J. W. B., Pelly, M., Xu, C., Thirumalai, K., Southon, J. R., Pavia F., and Hain, M. H. Simulating deglacial radiocarbon anomalies with pH-neutral geologic carbon. *Nature Geoscience*.

## IN PREP

**Green, R. A.,** Rafter, P. A., Edwards, C. A., and Hain, M. H. The isotopic fingerprint of marine CDR.

**Green, R. A.,** Rafter, P. A., Edwards, C. A., Fiechter, J., and Hain, M. H. Evaluating different mCDR methods and deployment locations within the California Current System ROMS.

## Awards, Fellowships, & Grants

|           |   |          |
|-----------|---|----------|
| 2024      | <b>Casey Moore Fund Award</b> , UCSC Earth and Planetary Sciences Department                    | \$2,500  |
|           | <b>Graduate Dean's Research Travel Grant</b> , UCSC Graduate Division                           | \$300    |
|           | <b>mCDR MRV Workshop Graduate Student Travel Grant</b> , Yale Center for Natural Carbon Capture |          |
| 2023      | <b>ARCS Fellowship</b> , Achievement Rewards for College Scientists Foundation                  | \$11,070 |
|           | <b>Graduate Dean's Research Travel Grant</b> , UCSC Graduate Division                           | \$100    |
| 2022      | <b>Teaching Assistant of the Year</b> , UCSC Earth Science Department                           |          |
|           | <b>Graduate Dean's Research Travel Grant</b> , UCSC Graduate Division                           | \$500    |
| 2021      | <b>Teaching Assistant of the Year-Honorable Mention</b> , UCSC Earth Science Department         |          |
| 2020      | <b>Teaching Assistant of the Year-Honorable Mention</b> , UCSC Earth Science Department         |          |
| 2019      | <b>Regents Fellowship</b> , UCSC Earth and Planetary Science Department                         | \$21,762 |
|           | <b>UNSW Summer Vacation Scholarship</b> , UNSW Climate Change Research Centre                   | \$3,800  |
| 2018      | <b>University Honors</b> , UC Davis   |          |
|           | <b>Departmental Citation</b> , UC Davis Environmental Science and Policy Department             |          |
| 2014-2017 | <b>Deans List</b> , UC Davis  |          |

## Presentations

<sup>+</sup> mentored undergraduate

### CONTRIBUTED PRESENTATIONS

**Green, R. A.,** Edwards, C. A., Rafter, P. A., Fiechter, J., and Hain, M. H., 2024. Evaluating mCDR using ROMS in the California Current System. Oral presentation: AGU, Washington, D.C.

**Green, R. A.,** Hain, M. H., Rafter, P. A., Edwards, C. A., and Fiechter, J., 2024. CDR efficiency and Carbon Isotopes: The Impact of OAE Deployment Size. Poster presentation: OSM, New Orleans, Louisiana.

**Green, R. A.,** Hain, M. H., Rafter, P. A., Edwards, C. A., and Fiechter, J., 2023. Fingerprinting CO<sub>2</sub> uptake using  $\delta^{13}C$  in ROMS. Poster presentation: AGU, San Francisco, California.

**Green, R. A.,** Hain, M. H., Rafter, P. A., Gray, W. R., Rae, J. W. B., and <sup>+</sup>Sun, C., 2023. Characterizing Geologic Carbon Release as an Explanation for Deglacial  $\Delta^{14}C$  Anomalies within the Eastern Tropical North Pacific. Oral presentation: AGU, Chicago, Illinois.

**Green, R. A.** 2022. Introduction to Paleoclimatology. Oral presentation: No Jargon Talks, Santa Cruz, California.

**Green, R. A.,** Hain, M. H., and Rafter, P. A. 2021. Constraints on Geologic Carbon Release at the End of the Last Ice Age from the Planetary Radiocarbon Budget. Oral presentation: AGU, New Orleans, Louisiana.

**Green, R. A.,** Hain, M. H., and Rafter, P. A. 2021. Constraining Earth's Geologic Influence on the Global Carbon Cycle During the Last Ice Age from the Planetary Radiocarbon Budget. Poster presentation: Goldschmidt, Virtual.

**Green, R. A.**, Hain, M. H., and Rafter, P. A. 2020.  $^{14}\text{C}$ -Constraints on the Deglacial Release of Geologic Carbon Using Atmospheric Records. Poster presentation: AGU, Virtual.

**Green, R. A.**, Menviel, L., Meissner, K. J. 2019. Evaluating seasonal sea-ice cover over the Southern Ocean at the Last Glacial Maximum. Oral presentation: PAGES C-SIDE workshop at ICP13, Sydney, Australia.

## Teaching Experience

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|             |   |      |
|-------------|---|------|
| Winter 2024 | <b>Intro to Environmental Sciences</b> , Teaching Assistant                 | UCSC |
| Winter 2023 | <b>Intro to Environmental Sciences</b> , Teaching Assistant                 | UCSC |
| Winter 2022 | <b>Intro to Environmental Sciences</b> , Teaching Assistant                 | UCSC |
| Winter 2021 | <b>Intro to Environmental Sciences</b> , Teaching Assistant                 | UCSC |
| Fall 2020   | <b>Intro to Computer Programming for Geoscientists</b> , Teaching Assistant | UCSC |
| Winter 2019 | <b>Intro to Environmental Sciences</b> , Teaching Assistant                 | UCSC |

## Mentoring

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|           |  |      |
|-----------|--|------|
| 2023-2025 | <b>Colin Zerfass</b> , Research Mentee               | UCSC |
| 2022-2024 | <b>David McCurdy</b> , Research Mentee               | UCSC |
| 2021-2024 | <b>Christopher Sun</b> , Research Mentee             | UCSC |
| 2023      | <b>Srishreya Arunsaravanakumar</b> , Research Mentee | UCSC |
| 2021      | <b>Beatrice O'Brien</b> , Research Mentee            | UCSC |
| 2021      | <b>Caden Kang</b> , Research Mentee                  | UCSC |
| 2021      | <b>Jack Chang</b> , Research Mentee                  | UCSC |

## Outreach & Professional Development

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### SERVICE AND OUTREACH

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|-----------|---|-----------|
| 2014-2017 | <b>UC Davis Football Special Olympics</b> , Volunteer   | Davis, CA |
| 2014-2017 | <b>Shriners Children's Hospital</b> , Volunteer         | Davis, CA |
| 2016      | <b>Evening of Dreams Special Needs Prom</b> , Volunteer | Davis, CA |

### LEADERSHIP

|              |  |                |
|--------------|--|----------------|
| 2022-present | <b>International Carbon Ocean Network for Early Career Scientists - ICONEC</b> , Founding Member | Santa Cruz, CA |
| 2018-2019    | <b>University of New South Wales</b> , Assistant Football Coach                                  | Sydney, AUS    |
| 2013-2017    | <b>UC Davis Football</b> , Division-1 Student Athlete  | Davis, CA      |

### PROFESSIONAL MEMBERSHIPS

Isometric Science Network  
American Geophysical Union  
Geochemical Society