Ryan A. Green

Marine Carbon Dioxide Removal · Biogeochemical modeling · Chemical Oceanography

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Summary

My research leverages carbon isotopes and biogeochemical modeling to enhance our understanding of marine carbon dioxide removal (mCDR) methods. Using carbon cycle models and regional ocean modeling systems (ROMS), I assess the safety, efficacy, and detectability of various mCDR approaches. Outside of academia, I provide scientific consulting on mCDR projects, with a focus on the development of Measurement, Reporting, and Verification (MRV) methodologies.

Education

University of California, Santa Cruz *Santa Cruz, CA*

PhD Earth Science *2019 - present*

- Dissertation: "Leveraging Carbon Isotopes to Evaluate the Potential of Ocean Alkalinity Enhancement for Marine Carbon Dioxide Removal"

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 - Present*

- Built a regional carbon cycle model and coupled to a global model to study geologic analogs of Ocean Alkalinity Enhancement (OAE) in the eastern tropical North Pacific
- Assessed the use of carbon isotopes for MRV after mCDR
- Simulated a range of OAE deployment scenarios within the California Current System using a coupled physical-biogeochemical model of ROMS and NEMUCSC, respectively

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.

In review

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.: Early Career Recommendations for Scaling an Equitable Marine Carbon Dioxide Removal Sector, *Perspectives of Earth and Space Scientists*, under review, submitted April 30, 2024, Manuscript ID: 2024CN000246.

In Prep

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

Green, R. A., Rafter, P. A., and Hain, M. H. Fingerprinting CO_2 uptake using $\delta^{13}C$.

Green, R. A., Rafter, P. A., Edwards, C. A., Fiechter, J., and Hain, M. H. Simulating OAE in the California Current System.

Awards, Fellowships, & Grants

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

Presentations

[+] *mentored undergraduate*

Contributed Presentations

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_2 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 [+]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, Lousiana.

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}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

Winter 2024	**Intro to Environmental Sciences**, Teaching Assistant	*UCSC*
Winter 2023	**Intro to Environmental Sciences**, Teaching Assistant	*UCSC*
Winter 2022	**Intro to Environmental Sciences**, Teaching Assistant	*UCSC*
Winter 2021	**Intro to Environmental Sciences**, Teaching Assistant	*UCSC*
Fall 2020	**Intro to Computer Programming for Geoscientists**, Teaching Assistant	*UCSC*
Winter 2019	**Intro to Environmental Sciences**, Teaching Assistant	*UCSC*

Mentoring

2023-present	**Colin Zerfass**, Research Mentee	*UCSC*
2022-2024	**David McCurdy**, Research Mentee	*UCSC*
2021-2024	**Christopher Sun**, Research Mentee	*UCSC*
2023	**Srishreya Arunsaravanakumar**, Research Mentee	*UCSC*
2021	**Beatrice O'Brien**, Research Mentee	*UCSC*
2021	**Caden Kang**, Research Mentee	*UCSC*
2021	**Jack Chang**, Research Mentee	*UCSC*

Outreach & Professional Development

Service and Outreach

2014-2017	**UC Davis Football Special Olympics**, Volunteer	*Davis, CA*
2014-2017	**Shriners Children's Hospital**, Volunteer	*Davis, CA*
2016	**Evening of Dreams Special Needs Prom**, Volunteer	*Davis, CA*

Leadership

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

Professional Memberships

Isometric Science Network
American Geophysical Union
Geochemical Society