ESTIMATING BLUE CARBON STORAGE POTENTIAL IN EARTH'S REMOTEST ATOLLS

Gaëlle Duchâtellier, Anna Bakker, Sam J. Purkis, Maria Estevanez[1], Rachael M. Heuer[2], Martin Grosell[2], and Amanda M. Oehlert

1) *Department of Environmental Science and Policy, Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami, Miami, FL, USA*

2) *Department of Marine Biology and Ecology, Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami, Miami, FL, USA*

PROJECT OBJECTIVE

- Quantify the extent of blue carbon ecosystems in ~70 atolls around the world
- Estimate potential carbon stocks in these atolls by leveraging > 30 publications on carbon sequestration in coastal ecosystems

PROJECT RATIONALE

Land use changes and energy demands have resulted in ~2,400 Gt CO_2 of net cumulative CO_2 emissions between 1850-2019 (Lee et al., 2023). As nations seek to mitigate the effects of climate change on decadal to centennial time scales, interest in natural carbon sinks has become an increasingly important focus of research in ecosystem management and climate policy. Several coastal ecosystems, including mangrove forests, salt marshes, and seagrass meadows, are considered natural carbon sinks and widely thought to disproportionately sequester carbon per unit area (Mcleod et al., 2011). Quantitative understanding of the amount of carbon stored in blue carbon ecosystems is currently an area of active research, but global mapping efforts suggest they extend over approximately 2.3 – 7.0 million km^2 (Duarte et al., 2013) and tens to hundreds of Tg C can be buried in these ecosystems annually (Mcleod et al., 2011).

Carbon sequestration by blue carbon ecosystems has been proposed to play a significant role in offsetting national CO_2 emissions in some island nations, like in the Republic of Kiribati and the Bahamas, where carbon-neutrality may be possible (Friess,

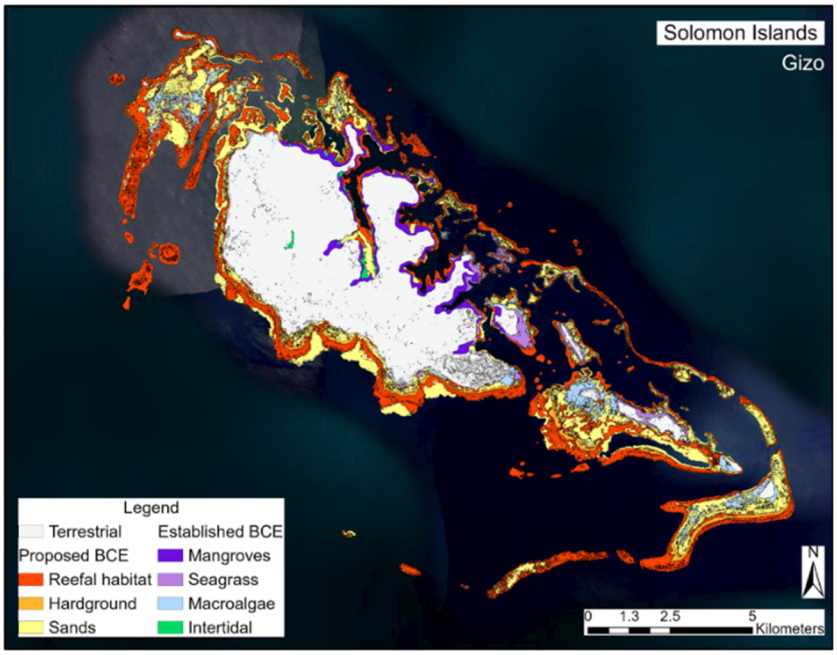

Figure 1: Mapped extent of coastal habitats, including established and proposed blue carbon ecosystems, in the Gizo atoll of the Solomon Islands.

2023). Nature-based strategies for carbon dioxide removal may be particularly important for small island developing states, since they often contain disproportionately high densities of blue carbon ecosystems (Friess, 2023). To properly evaluate carbon dioxide removal by blue carbon ecosystems in these often remote settings, accurate and consistent measurements of carbon sequestration must be conducted globally. Problematically, spatial variability in ecosystem characteristics, insufficient sample sizes, and inconsistent methodology between studies is known to produce significant ranges in potential carbon stocks (Fest et al., 2022) and mapping of small habitat patches on global satellite datasets can be exceedingly challenging (Friess, 2023).

APPROACH

To assess blue carbon sequestration in Earth's remotest atolls, we reanalyzed the high-resolution, globally-resolved, ground-truthed dataset of coastal habitats produced by the Khaled bin Sultan Living Oceans Foundation Global Reef Expedition (Purkis et al., 2019) to generate 69 new maps of blue carbon ecosystem extent. Habitat fragmentation will be assessed on these new maps to support the development of targeted management plans. Leveraging regional and global carbon sequestration rates reported in more than 30 journal articles, we will estimate the potential range of carbon sequestered in these ecosystems, many of which for the first time.

SIGNIFICANCE

The results of this study are anticipated to provide a comprehensive overview of habitat composition, spatial distribution, and associated organic carbon stocks in atolls mapped by the Global Reef Expedition. Of the ~70 atolls investigated, several have never been considered in prior blue carbon budgets, particularly in the Pacific Ocean. Thus, new results will contribute to a more robust baseline understanding of the carbon stocks in blue carbon ecosystems around the world.

REFERENCES

Friess, D. A. (2023). The potential for mangrove and seagrass blue carbon in Small Island States. Current Opinion in Environmental Sustainability, 64, 101324.

Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P. W., Trisos, C., Romero, J., Aldunce, P., Barrett, K., Blanco, G., Cheung, W. W. L., Connors, S., Denton, F., Diongue-Niang, A., Dodman, D., Garschagen, M., Geden, O., Hayward, B., … Péan, C. (2023). IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland. (First). Intergovernmental Panel on Climate Change (IPCC).

Mcleod, E., Chmura, G. L., Bouillon, S., Salm, R., Björk, M., Duarte, C. M., Lovelock, C. E., Schlesinger, W. H., & Silliman, B. R. (2011). A blueprint for blue carbon: Toward an improved understanding of the role of vegetated coastal habitats in sequestering CO 2. Frontiers in Ecology and the Environment, 9(10), 552–560.

Purkis, S. J., Gleason, A. C. R., Purkis, C. R., Dempsey, A. C., Renaud, P. G., Faisal, M., Saul, S., & Kerr, J. M. (2019). High-resolution habitat and bathymetry maps for 65,000 sq. Km of Earth's remotest coral reefs. Coral Reefs, 38(3), 467–488.