frontiers | Frontiers in Marine Science

TYPE Editorial
PUBLISHED 01 June 2023
DOI 10.3389/fmars.2023.1212305

OPEN ACCESS

EDITED AND REVIEWED BY
Eric 'Pieter Achterberg,
Helmholtz Association of German Research Centres (HZ), Germany

*CORRESPONDENCE
Jeng-Wei Tsai
tsaijw@mail.npust.edu.tw
Keisuke Nakayama
nakayama@phoenix.kobe-u.ac.jp

RECEIVED 26 April 2023
ACCEPTED 23 May 2023
PUBLISHED 01 June 2023

CITATION
Tsai J-W and Nakayama K (2023) Editorial: Carbon dynamics in freshwater, coastal and oceanic ecosystems in response to the SDG goals.
Front. Mar. Sci. 10:1212305.
doi: 10.3389/fmars.2023.1212305

Editorial: Carbon dynamics in freshwater, coastal and oceanic ecosystems in response to the SDG goals

Jeng-Wei Tsai[1]* and Keisuke Nakayama[2]*

[1]Graduate Institute of Bioresources, National Pingtung University of Science and Technology, Pingtung, Taiwan, [2]Graduate School of Engineering, Kobe University, Kobe, Japan

KEYWORDS

dissolved organic matters (DOM), blue carbon, climate change, natural solution, hydrological modeling

Editorial on the Research Topic
Carbon dynamics in freshwater, coastal and oceanic ecosystems in response to the SDG goals

Introduction

Ocean and coastal areas are buffers against global warming by absorbing 23% CO2 from the atmosphere (Sabine et al., 2004; DeVries et al., 2017). Significantly, coastal and oceanic vegetated ecosystems (such as wetlands, corals, mangroves, seagrass meadows, and kelps), so-called "blue carbon ecosystems" (B.C.E.), have been paid attention to absorb and sequester carbon dioxide from the atmosphere (Nellemann et al., 2009). Recently, freshwater carbon ecosystems, such as lakes, ponds and reservoirs, have also been revealed to contribute to atmospheric carbon sequestration. However, variations in climate patterns, biodiversity spectrums, and anthropogenic activities (e.g., non-sustainable resource extraction, land-based pollution and habitat degradation) across the ecosystems could alter the fragile balance of B.C.E. as carbon sinks or sources (Malhi et al., 2020; Abbass et al., 2022). Also, higher spatiotemporal carbon flux variation was observed in coastal and estuary ecosystems due to intensive anthropogenic activities, natural biological processes, and fluctuating terrestrial loads (Asmala et al., 2016, Asmala et al., 2020). Consequently, understanding the factors and processes that drive the spatiotemporal variations in Dissolved Organic Matter (D.O.M.) quantity and quality under changing environmental conditions would benefit the sustainable use of natural resources in freshwater, coastal and oceanic ecosystems. To contribute to the S.D.G. Goals in Climate Action (Goal 13) and Life Below Water (Goal 14), this Research Topic focuses on carbon dynamics, e.g., GHG emission/storage (blue carbon), as well as environmental stresses such as acidification, fishery resource and pollution (e.g., eutrophication, dead zone and metal pollution) in freshwater, coastal and oceanic ecosystems. Eleven research articles were collected on this Research Topic, as summarized below.

Shallow coastal waters have attracted due to their strong carbon sequestration capacity. Macroalgae culture is considered a natural-based solution for marine carbon sequestration.

Research Topics revealed that carbon sequestration by kelp culture is applicable; 5% of DOC released by *S. japonica* was transformed to refractory DOC, and an estimated 1–2% of the net primary production of cultured kelp was sequestrated as refractory DOC. Also, tidal flats are expected to have the same carbon sequential potential as shallow coastal areas. However, the complicated temporal and spatial variation of carbon dioxide (CO_2) makes it difficult to accurately estimate the air-water CO_2 fluxes (fCO_2). For example, the size of an Submerged Aquatic Vegetation (S.A.V.) patch significantly affects flows and carbon sequestration. In contrast to small-scale phenomena, the higher fCO_2 values in the cyclonic and non-eddy regions were revealed due to the upwelling, increasing the surface fCO_2. Additionally, physical processes (such as the residence time and water depth) drive CO_2 and O_2 temporal and spatial patterns; otherwise, biological processes (benthic algae biomass and respiration) may also affect variability within lakes, ponds and reservoirs.

From the water quality perspective, nutrient pollution threatens the seagrass community and may adversely affect their carbon sequestration potential, diminishing the carbon sequestration potential of seagrass ecosystems. Higher nutrient loading elevated labile organic carbon content (e.g., free amino acids and soluble sugars). Contrary, refractory organic carbon compositions of seagrass tissues (i.e., cellulose-associated organic matter) decreased with increasing nutrient loading. Also, an urbanized enclosed bay has environmental problems, such as hypoxia, which degrades carbon dioxide absorption from the atmosphere to the water surface.

As a necessity of new research, the importance of "blue carbon" (marine carbon) in the global quest to achieve carbon neutrality has been well understood. However, freshwater carbon has yet to be considered as a climate change mitigation approach, although freshwater areas (5.0 million km^2) are more extensive than coastal areas (1.8 million km^2) and are expected to have more significant potential for carbon sequestration. Therefore, we need more investigations on both not only marine carbon but also freshwater carbon. The results of this study provide new and deeper insights into coastal carbon dynamics to propose climate change mitigation in future climate and to achieve the S.D.G.s.

Author contributions

J-WT and KN structured this Research Topic. All guest editors have edited and reviewed the editorial articles, and approved the submitted version.

Funding

This study was supported by National Science and Technology Council, Taiwan, R.O.C. (MOST 111-2313-B-039 -001 -MY3) for J-WT. Also, This study was supported by Japan Society for the Promotion of Science, Japan (18KK0119, 22H01601, 22H05726) for KN.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Abbass, K., Qasim, M. Z., Song, H., Murshed, M., Mahmood, H., and Younis, I. (2022). A review of the global climate change impacts, adaptation, and sustainable mitigation measures. *Environ. Sci. Pollut. Res.* 29, 42539–42559. doi: 10.1007/s11356-022-19718-6

Asmala, E., Kaartokallio, H., Carstensen, J., and Thomas, D. N. (2016). Variation in riverine inputs affect dissolved organic matter characteristics throughout the estuarine gradient. *Front. Mar. Sci.* 2. doi: 10.3389/fmars.2015.00125

Asmala, E., Osburn, C. L., Paerl, R. W., and Paerl, H. W. (2020). Elevated organic carbon pulses persist in estuarine environment after major storm events. *Limnology Oceanography Lett.* 6, 43–50. doi: 10.1002/lol2.10169

DeVries, T., Holzer, M., and Primeau, F. (2017). Recent increase in oceanic carbon uptake driven by weaker upper-ocean overturning. *Nature* 542, 215–218. doi: 10.1038/nature21068

Malhi, Y., Janet, F., Nathalie, S., Martin, S., Monica, G. T., Christopher, B. F., et al. (2020). Climate change and ecosystems: threats, opportunities and solutions. *Philos. Trans. R. Soc. B.* 375:20190104. doi: 10.1098/rstb.2019.0104

Nellemann, C., Corcoran, E., Duarte, C. M., Valdes, L., De Young, C., Fonseca, L., et al. (2009). *Blue carbon. a rapid response assessment* (GRID-Arendal, Birkeland Trykkeri AS, Birkeland: United Nations Environmental Programme).

Sabine, C. L., Feely, R. A., Gruber, N., Key, R. M., Lee, K., Bullister, J. L., et al. (2004). The oceanic sink for anthropogenic CO_2. *Science* 305, 367–371. doi: 10.1126/science.1097403