DOSI DEEP-OCEAN STEWARDSHIP INITIATIVE

POLICY BRIEF

November 2023

Marine Carbon Dioxide Removal: Ocean Impacts and Policy Needs

Key Messages

- The ocean is now a central focus of efforts to remove carbon dioxide from the atmosphere and mitigate climate change.
- The deep ocean is increasingly being considered as a location to dispose of carbon. Techniques used to do this at scale can have serious impacts on ocean ecosystems and the benefits they provide to humans.
- Coordinated policy decisions can help ensure that efforts to research and apply marine carbon dioxide removal do not cause more harm than benefit.

What Is Marine Carbon Dioxide Removal?

Marine Carbon Dioxide Removal (mCDR) refers to a range of ideas for removing planet-heating carbon from the atmosphere and storing it in the deep ocean. While no such ideas have been applied at scale yet, their impacts on ocean environments are likely to be significant.

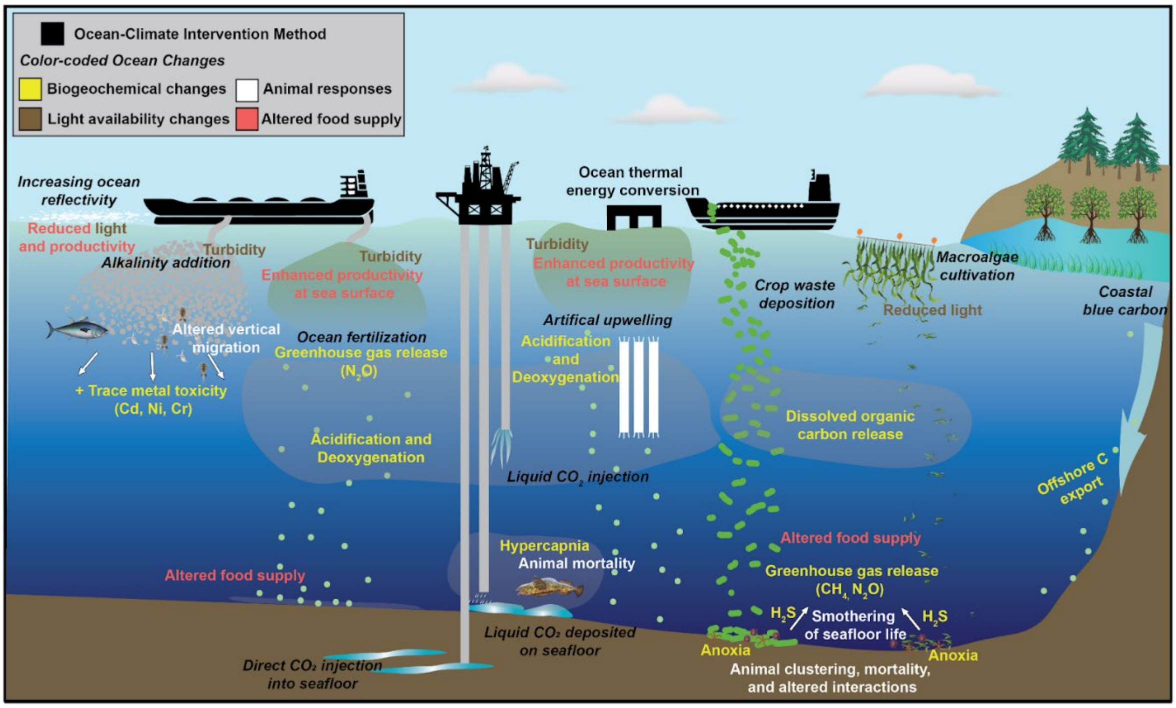

Figure 1: Several concepts for Ocean-Based Climate Interventions, including mCDR, along with their corresponding impacts on ocean environments.

Methods of Marine Carbon Dioxide Removal

Several ideas for mCDR that have been raised by industry, researchers, and governments are:

- **Deep-ocean disposal of crop and wood waste,** keeping that waste from releasing carbon back into the atmosphere when it decays.
- **Growing seaweed and sinking it to the deep ocean.**
- **Ocean Alkalinity Enhancement**, speeding the ocean and seafloor's ability to remove atmospheric carbon dioxide by adding alkaline material to seawater.
- **Direct injection of liquid carbon dioxide** in deep water or below the seafloor.
- **Ocean Fertilization or artificial upwelling**, which add nutrients to seawater to encourage plankton growth. These plankton would absorb carbon dioxide and would sink after death.

Impacts on the Deep Ocean

Applying mCDR techniques at a wide enough scale to affect Earth's climate would transform the chemistry and biology of the ocean.

- Decaying plant matter or seaweed on the ocean floor will deplete oxygen in the area, killing ocean life and reducing biodiversity.
- Seaweed and crop waste could release large amounts of organic material while sinking. This would alter the ocean's microbial activity and oxygen availability, which may shift the ranges of or directly harm species targeted by fisheries.
- After sinking, seaweed and crop waste would disturb massive regions of the seabed by smothering animals and creating sudden spikes in food available to deep-ocean species. This would change how species interact, potentially harming commercial harvest of fish and shellfish.
- Sunken plant matter or seaweed could help produce toxic hydrogen sulfide or methane, a potent greenhouse gas.
- Liquid carbon dioxide injected just above the seabed would suffocate animals on or near the bottom of the ocean.
- Capturing carbon by enhancing plankton growth will intensify oxygen consumption and increase carbon dioxide production in the midwater. This may negatively affect the behavior, growth, and survival of animals that live there, including commercial species.
- Raising the ocean's alkalinity could release associated trace elements like cadmium, nickel and chromium into deep waters, harming ocean life.

Taken together, the changes described above may have unforeseen or unwanted consequences for critical ecosystem services provided by the deep ocean, including carbon and nutrient cycling, remineralization, fisheries, or the support of threatened or endangered species. These impacts need to be considered when assessing the value or scale of such techniques to enable effective policy decisions.

Opportunities to Consider These Risks in Policy

UNFCCC Article 6.4-SB003-AO3. Accounting for carbon dioxide removal should require a whole life cycle analysis including a review of lost carbon sequestration services associated with environmental impacts of mCDR techniques. These losses will have to be studied and monitored over long time periods. Most ocean-based carbon removal technologies will disrupt finely balanced marine ecosystems in midwater and at the seafloor. Because these marine ecosystems play major roles in carbon uptake, transformation, transfer, storage, and burial (all part of sequestration) any changes that affect the carbon cycle or other greenhouse gasses should be understood and accounted for, including long-term effects.

SBSTA – Research and Systemic Observation. Developing effective climate mitigation strategies will require science to better understand the ocean carbon cycle. Key advances should include adoption and measurement of deep-ocean-appropriate Essential Ocean Variables by the Global Ocean Observing Strategy (GOOS) in partnership with the Deep Ocean Observing Strategy (DOOS). Building capacity in the Global South to expand deep ocean observing will also be important.

The Global Stocktake. Greater inclusion of the ocean in the GST is necessary. This should include metrics related to the carbon cycle and ecological measures that can document effectiveness and impacts of mCDR techniques as they are deployed.

NDCs and NAPs. Nationally Determined Contributions and National Adaptation Plans can critically assess benefits and risks of mCDR in national waters and beyond.

The IPCC. The Intergovernmental Panel on Climate Change should sponsor critical assessments of carbon capture, duration, environmental impacts, and other effects of mCDR technologies. This should include a review of effects on the deep ocean and could take the form of a special report.

Harmonization across UN Instruments. To maximize mCDR benefits and minimize negative consequences, the scientific and technical portions of the relevant regulatory bodies (the London Protocol/London Convention, the Convention on Biological Diversity, the BBNJ Agreement, and the UNFCCC) should convene a joint commission focused on mCDR. This commission should engage experts from the World Ocean Assessment, IPCC, IPBES, GESAMP, and the International Panel for Ocean Sustainability (IPOS).

Prepared by DOSI members:

Lisa Levin, Sarah Seabrook, and Brandon Gertz

About DOSI:

The Deep-Ocean Stewardship Initiative is a global network of experts that integrate science, technology, policy, law and economics to advise on ecosystem-based management of resource use in the deep ocean and strategies to maintain the integrity of deep-ocean ecosystems within and beyond national jurisdiction.

Contact us: DOSIcomms@gmail.com

How to Cite:

DOSI (2023). "Marine Carbon Dioxide Removal: Environmental Impacts and Policy Steps" – Policy Brief. Deep-Ocean Stewardship Initiative. **https://www.dosi-project.org/wp-content/uploads/deep-OBCIs-policy-brief.pdf**

Key Reference:

Levin, Lisa A., Joan M. Alfaro-Lucas, Ana Colaço, Erik E. Cordes, Neil Craik, Roberto Danovaro, Henk-Jan Hoving, Jeroen Ingels, Nélia C. Mestre, Sarah Seabrook, Andrew R. Thurber, Chris Vivian, Moriaki Yasuhara. 2023. Deep-sea impacts of climate interventions. Science 379: 978-981