Challenges and Opportunities in marine Carbon Dioxide Removal

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Current CO₂ Mitigation Strategy Hercules' Fifth Labor: The Augean stables

Every night the cowherds, goatherds and shepherds drove thousands of animals to King Augeas' stables. The largest in Greece, the stables had never before been cleaned. Eurystheus ordered Hercules to clean up the stables in a single day. To complete the task, Hercules directed his great strength not to lift out the dung, a truly arduous task, but rather to tear an opening in the wall of the stables. Then he made another opening in the wall on the opposite side of the yard. Next, he dug wide trenches to two rivers which flowed nearby. The rivers rushed through the stables, flushing them out... and gave birth to the adage:



'The solution to pollution is dilution!'



Andy Lovell, "Augean Stables" Collyer-Bristow Gallery

Hercules.smercgames.com





www.rudylimberger.com

3 Big Challenges to mCDR as a climate solution

- 1) The need to avoid results like the London Convention on Iron where it associates fertilization impacts as a pollution concern. Engagement, transparency, inclusiveness, and deliberative and robust science is key.
- 2) The need to build a science capacity of oceanographers fluent in not only the basic science with the expectation of getting careers in academia or government but who embrace the societal/political/legal context to enable a solutions-oriented corporate and NGO workforce
- 3) Logistics Tracking purposeful changes to the ocean carbon cycle will be daunting. Robust Measuring, Monitoring, Reporting, and Verification (MMRV) would seem to require both:
 - measurements at choke points such as rivers and channels
 - Inclusion of globally consistent tracer release protocols across direct CO2 injection, alkalinization, and iron fertilization.

Navigating Pollution vs Climate Change Prevention

https://www.imo.org/en/OurWork/Environment/Pages/OceanFertilization-default.aspx

"CONCERNED about the potential widespread, long-lasting or severe impacts on the marine environment of the placement of matter from unregulated ocean fertilization activities and other proposed marine geoengineering techniques, and determined to put in place a science-based, global, transparent and effective control and regulatory mechanism for such activities"



Marine Environment

- ✓ Pollution Prevention
- Pollution Preparedness and Response
- Ballast Water
 Management
- ✓ Biofouling

Anti-fouling systems

➤ Ship Recycling

Port Reception facilities

Ocean Fertilization under the LC/LP

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The "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972", (London Convention), in force since 1975, was one of the first global conventions to protect the marine environment from human activities. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter. In 1996, the Contracting Parties adopted a Protocol to the London Convention (London Protocol) to further modernize the Convention and, eventually, replace it. The London Protocol came into force in March 2006. Currently 87 States are party to the Convention and 44 States are party to the Protocol.

Developing an Ocean Solutions workforce

https://oceanvisions.org/events/oceanvisions-2021-summit/



Registration and Call for Abstracts NOW OPEN

DEADLINE April 1, 2021





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Measuring, Monitoring, Reporting and Verification

- Can a change be measured over natural variability?
- Is that technology readily available, accessible, and reproducible across potential sites and/or across the global ocean?
- Can durability be confidently assessed?
- Can ecosystem consequences be detected and attributed?
- These require extensive and ongoing observing and modeling capabilities!



Winning and Losing in the mCDR game

- What does winning look like? Implementation of mCDR solutions that leverage ecological enhancement (e.g. restoring productivity, biomass, wetlands, seagrasses, eutrophication)
- What does losing look like? Promotion of enhanced fossil fuel use with non-durable and polluting mCDR (e.g. direct CO2 injection in the Gulf of Mexico that impacts corals and degrades marine systems through enhanced ocean acidification and hypoxia)