"Research Governance for Ocean-based Carbon Dioxide Removal"

Abstract: Ocean-based carbon dioxide removal (CDR) [1] is gaining interest among scientists, policymakers, and entrepreneurs as a strategy for reducing atmospheric carbon dioxide concentrations to lessen anthropogenic climate change. Nevertheless, key questions remain unanswered about ocean-based CDR technologies, including: what is their additional carbon sequestration potential? How can we measure and verify long-term carbon sequestration? How will implementation impact the human and marine environment, and are these costs worth any proven carbon sequestration benefit? We must answer these questions before we can decide whether ocean-based CDR should be implemented at the gigaton scale. Consequently, responsible research should seek to answer these questions. Nevertheless, an ad hoc and ungoverned research agenda may itself lead to adverse environmental impacts, inequitable outcomes, and undue risk to communities and the ocean, which may subsequently erode social license and generate significant public opposition to ocean-based CDR. [2] We therefore propose a governance framework for ocean-based CDR research. Our framework aims to ensure that research is conducted in a manner that advances promising methods while eliminating excessively risky or unverifiable methods; facilitates public, rightsholder, and stakeholder engagement; and requires investigation of and transparency about risks to the human and marine environment. Principles of our governance framework will include:1. A tiered structure requiring demonstration of feasibility through modeling and lab research prior to in situ experimentation.2. Full consideration and disclosure of environmental impacts, and a scheme that seeks to avoid, minimize, and mitigate impacts.3. Assignment of responsibility and liability for impacts, including experiment decommissioning.4. Public, rightsholder, and stakeholder engagement for all research activities that is equitable, inclusive, and fosters capacity building.5. Transparency in research funding and avoidance of conflicts of interest.[1] Technologies include nutrient fertilization, artificial upwelling and downwelling, electrochemical methods, seaweed cultivation, and ocean alkalinity enhancement. See NAS, A Research Strategy for Ocean CDR and Sequestration, https://www.nationalacademies.org/our-work/a-research-strategy-for-ocean-carbon-dioxide-removal-and-sequestration. We exclude blue carbon, because research risks are minimal, and carbon removal and ecological impacts are well-demonstrated.[2] E.g., Gannon & Hulme, Geoengineering at the "Edge of the World": Exploring perceptions of ocean fertilisation through the Haida Salmon Restoration Corporation, Geo (2018).