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Ethical Pathways for Ocean Solutions: Guiding Principles for Responsible Climate Intervention Research

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Climate change requires urgent and coordinated global action. Increasingly, the world is considering technology-based climate intervention approaches, often called geoengineering, for many different potential applications from terrestrial, to oceans, to stratospheric research areas of interest. The ocean plays a central role in regulating Earth's climate, absorbing over 90% of excess heat and nearly a quarter of anthropogenic carbon dioxide emissions. As the impact of climate change intensifies, ocean scientists are increasingly called upon to explore novel strategies for mitigation and adaptation, including marine-based carbon dioxide removal (mCDR), ocean alkalinity enhancement, and other climate intervention approaches. Many of these approaches are untested and the consequences are not yet well understood, especially in marine environments that are transboundary, deeply interconnected, and often poorly understood.

While climate intervention research has been justified as necessary to expand the range of options available to policy makers in the future, many questions remain on efficacy, risks and potential harm versus potential benefits. These emerging technologies raise urgent questions about ecological risks, governance, and equity. The need for an ethical framework to help guide this area of growing research interest has never been more acute, as both governmental and private sector funding has accelerated in this area over the past 18 months.

To support responsible research and decision making, the American Geophysical Union (AGU) published an Ethical Framework for Climate Intervention Research in October 2024. Developed with input from scientists, ethicists, community voices, youth advocates, and more, this framework outlines five guiding principles: responsible research practices, holistic climate justice, inclusive public participation, transparency, and informed governance. This presentation will review recent developments in this field of climate geoengineering research and examine how these principles apply specifically to ocean-based climate interventions, highlighting the ethical dimensions of marine research, stakeholder engagement, policy development, and the ongoing process for global dissemination and engagement. By embedding ethical standards into ocean science, researchers can help ensure that climate solutions are not only scientifically sound but also socially just and ecologically responsible.