



RESEARCH BRIEF

FEBRUARY 2020

Ocean Solutions That Address Climate Change Effects

Oceans are already playing a significant role in mitigating climate change, offering major opportunities for additional actions to reduce CO₂ and lessen some of the acute impacts facing marine ecosystems. Research from Stanford analyzes ways the ocean could make even greater contributions to combating climate change.

The analysis suggests that scaling measures found to be consistently favorable, such as those focused on ocean-based sources of renewable energy and localized solutions, showed most promise for success. Researchers had lower levels of confidence in measures determined to be less reliable or controversial like solar radiation management. Further study to allow for better scientific understanding is needed along with government engagement to both inform future policy and decision making as well as develop and promote emerging technologies.

Background

Oceans currently absorb over 90% of the heat emitted by the planet and remove approximately 25% of carbon emissions — but have the potential to remove and store much more.

POINTS FOR POLICY MAKERS

- ▶ **Decisions favoring any measure must consider multiple criteria, including effectiveness, feasibility, co-benefits/disbenefits, governability and cost effectiveness, rather than only the climate-related effectiveness or cost effectiveness.** For example, alkalization interventions score high in global mitigation potential, but low in technological readiness or global governability. In contrast, locally implemented measures such as reducing pollution have strong co-benefits and high governability leading to better outcomes.
- ▶ **‘No-regret’ measures with demonstrated potential effectiveness, co-benefits and little or no disbenefits should be deployed immediately.** As other potential solutions are explored, high-confidence measures like development of ocean-based renewable energy programs and expansion of marine protected areas (MPAs) should be widely implemented.
- ▶ **Multiple actions are needed to increase chances of avoiding or countering climate impacts as it is unlikely that a single measure will be able to meet a pathway consistent with the Paris Agreement.** Relying solely on ocean-based measures with relatively high global effectiveness, such as albedo enhancement, but with significant possible adverse side effects on marine ecosystems is counterproductive. Conversely, deploying only local measures that rank high in terms of governability and co-benefits, but offer only a moderate ability to reduce climate-related impacts, has limited potential for wider-scale mitigation efforts.
- ▶ **Diplomatic and political efforts must be accelerated internationally to improve existing measures, develop new agreements, and create mechanisms to coordinate global to local actions.** Climate change intervention at multiple scales requires participation from numerous and diverse actors, especially within institutions such as the UNFCCC and the UN Convention on Biological Diversity. In addition to being central to decisions on global measures, the assessment suggests that the international community can play an indirect supporting role when implementing local solutions.

To guide the development and implementation of technologies and actions that could lead to sustainable outcomes, a group of scholars from Stanford and other leading research institutions performed a comprehensive assessment of 13 global- and local-scale, ocean-based measures deemed most likely to result in the positive reduction of three main climate-related drivers: ocean warming, acidification and sea level rise. Those measures fell into four main categories:

- Reduction of GHG emissions by increasing ocean-based renewable energy programs; restoring/conserving coastal vegetation; fertilizing oceans with soluble iron; reducing acidity through alkalization applications; and various hybrid land-marine techniques using biomass to fuel energy, provide carbon storage or create biochar.
- Solar radiation management, including marine cloud brightening and enhancing ocean surface albedo, intended to increase reflection of solar energy.
- Protecting plants, animals and ecosystems through pollution reduction measures; managing water quality of coastal river and stream outflows; eliminating over-exploitation of threatened resources; and creating and/or expanding marine habitats using mechanisms like marine protected areas (MPAs).
- Manipulated adaptation measures that include assisted evolution of species and relocation and restoration of reefs.

All of the evaluated measures have tradeoffs, but those with greatest benefit combined global and local solutions, some of which could be implemented or scaled-up immediately. Researchers also noted that decisions favoring any measure should consider multiple criteria, including effectiveness, feasibility, co-benefits/disbenefits, governability and cost effectiveness, rather than just the climate-related effectiveness or cost effectiveness alone.

The reviewers also determined that governance mechanisms and political consistency must be incorporated effectively and employed widely for any ocean-based initiatives to succeed. They noted that global measures are more effective than local ones in addressing the climate problem, but they are generally more difficult to implement due to challenges in global governance. Therefore, establishing multiple-scale and multiple-stakeholder initiatives, both globally and locally, were also identified as essential to producing impactful and lasting outcomes.

ABOUT THE AUTHOR



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This brief is based on: **Ocean Solutions to Address Climate Change and Its Effects on Marine Ecosystems** published in *Frontiers in Marine Science* (2018).



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