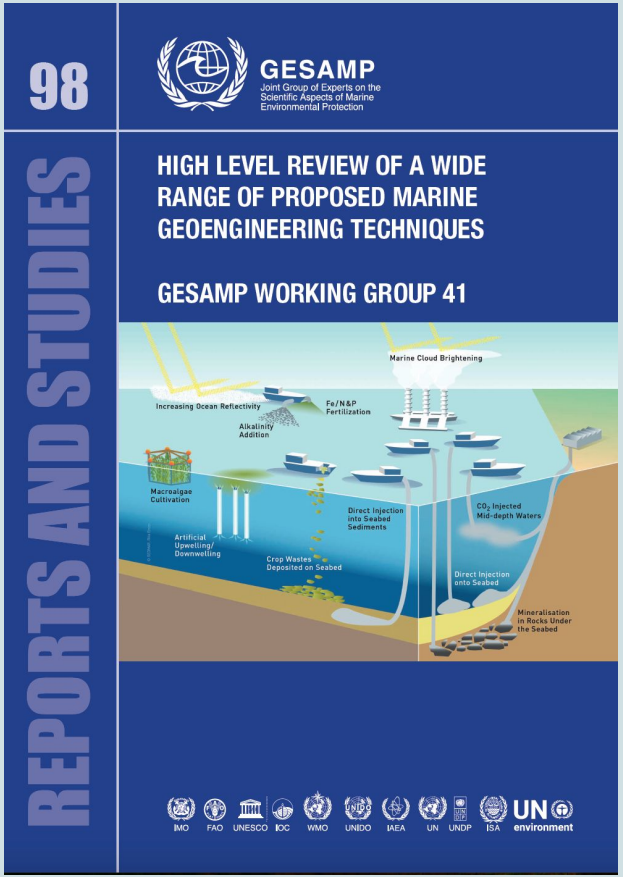
Marine geoengineering (MGE):

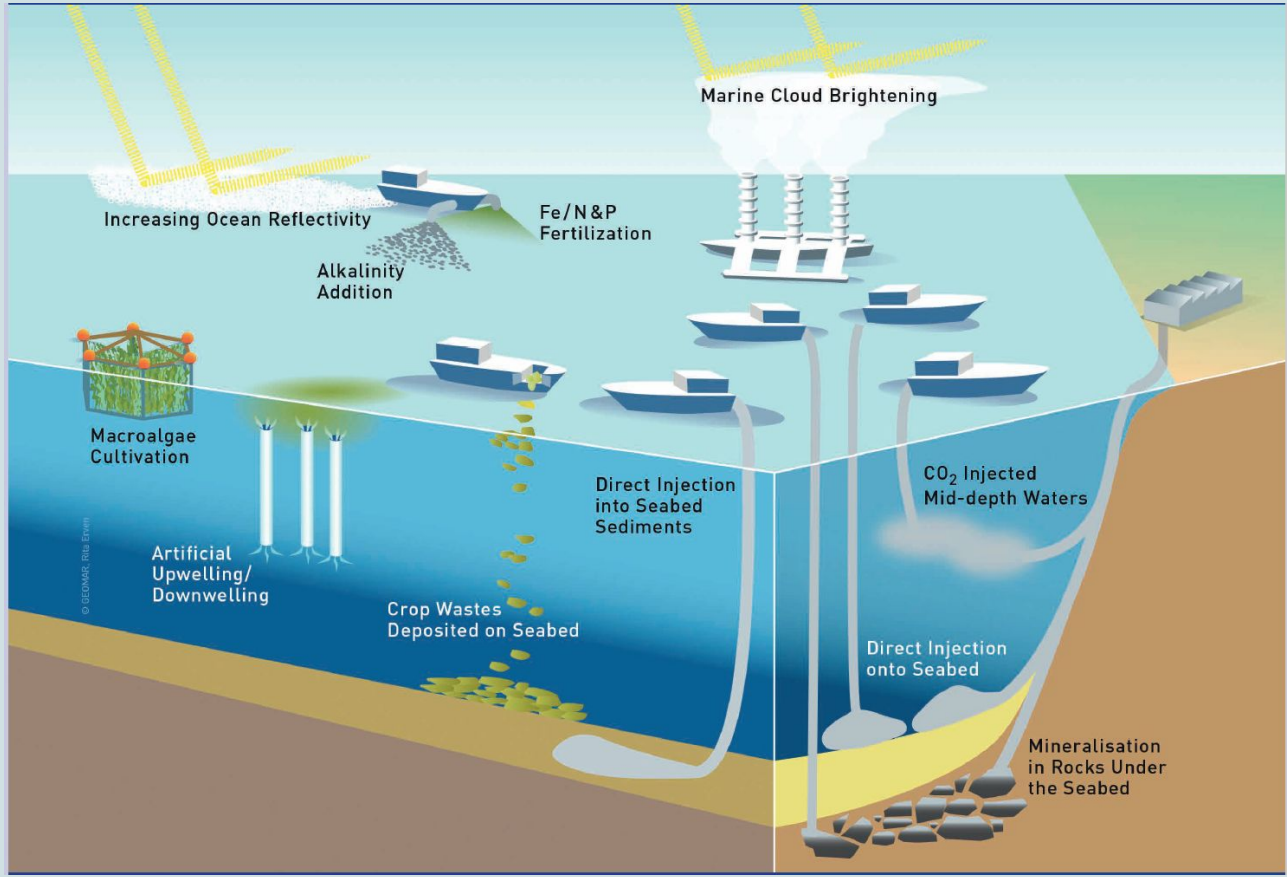
Potential relevance to migratory species
in the context of marine pollution

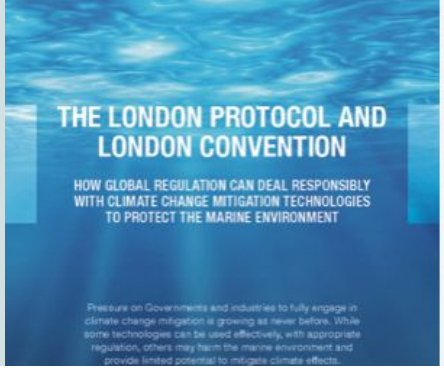
CMS Marine Pollution Workshop, 30th May 2025

David Santillo & Paul Johnston
Greenpeace Research Laboratories

Marine geoengineering (MGE) - GESAMP report, 2019







Marine Environment
- Pollution Prevention
- Pollution Preparedness and Response
- Ballast Water Management
- Biofouling
  - Anti-fouling systems
- Ship Recycling
  - Port Reception facilities
  - Special Areas under MARPOL
  - Particularly Sensitive Sea Areas
- London Convention and Protocol
  - Compliance with the London Convention and Protocol
  - Reporting of Dumping
  - The LC/LP and Climate Change
  - New and emerging issues
  - Science Day

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

Home ⟶ Our Work ⟶ Marine Environment ⟶ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

The "Convention on the Prevention of Marine Pollution by Dur
"London Convention" for short, is one of the first global conve
human activities and has been in force since 1975. Its objecti
of marine pollution and to take all practicable steps to preven
other matter. Currently, 87 States are Parties to this Conventic

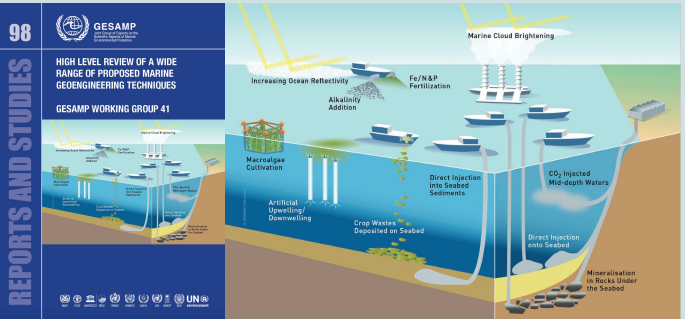
50 years of the London Convention

In 2022, IMO is marking fifty years since the adoption of the L
Convention was a major achievement, which, along with the 1
Environment in Stockholm, constituted the first steps to truly
responsibility for the harm humans have done to the ocean.

Download infographic illustrating the main steps taken und

Related Documents

- Full text of the London Protocol and 1996 amendments
- Full text of the London Convention
- Map of current LC-LP Parties (April 2022)
- Information leaflet about



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- London Convention and Protocol
  - GESAMP
- Technical Assistance

Marine geoengineering

Home ⟶ Our Work ⟶ Marine Environment ⟶ Marine geoengineering

Guidance and Amendments under the London Convention/Protocol

Since 2007, having decided that the scope of work of the LC and LP included ocean fertilization, the Contracting Parties have been working to establish, a global, transparent and effective control and regulatory mechanism for ocean fertilization activities and other activities that fall within the scope of the LC and LP and have the potential to cause harm to the marine environment. In 2010, Parties adopted Resolution LC-LP.2(2010) on the "Assessment Framework for Scientific Research Involving Ocean Fertilization" which guides Parties on how to assess proposals for ocean fertilization research and provides detailed steps for completion of an environmental assessment, including risk management and monitoring.

In 2013, the Contracting Parties adopted resolution LP.4(8), thereby amending the Protocol to include marine geoengineering engineering activities.

The amendments, adopted on 18 October 2013 by the Protocol Parties, add a new article 6bis which states that "Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in Annex 4, unless the listing provides that the activity or the sub-category of an activity may be authorized under a permit".

Marine geoengineering is defined as "a deliberate intervention in the marine environment to manipulate natural processes, including to counteract anthropogenic climate change and/or its impacts, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long-lasting or severe".

A new Annex 4 on "Marine geoengineering" lists "Ocean fertilization", defined as "any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans. Ocean fertilization does not include conventional aquaculture, or mariculture, or the creation of artificial reefs. " The Annex provides that all ocean fertilization activities other than those referred to above shall not be permitted. An ocean fertilization activity may only

The 8th Meeting of Contracting Parties to the LP adopted amendments to include marine geoengineering under the Protocol

LP/LC STATEMENT ON MARINE GEOENGINEERING (2022)

- STATEMENT ON MARINE GEOENGINEERING

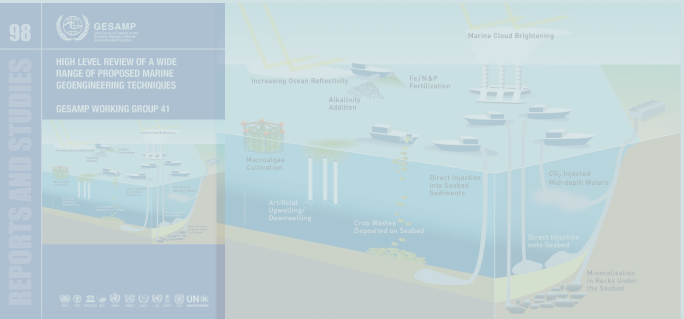
  The 44th Consultative Meeting of Contracting Parties to the London Convention and the 17th Meeting of Contracting Parties to the London Protocol (LC 44/LP 17) adopted a statement on marine geoengineering techniques for climate change mitigation.

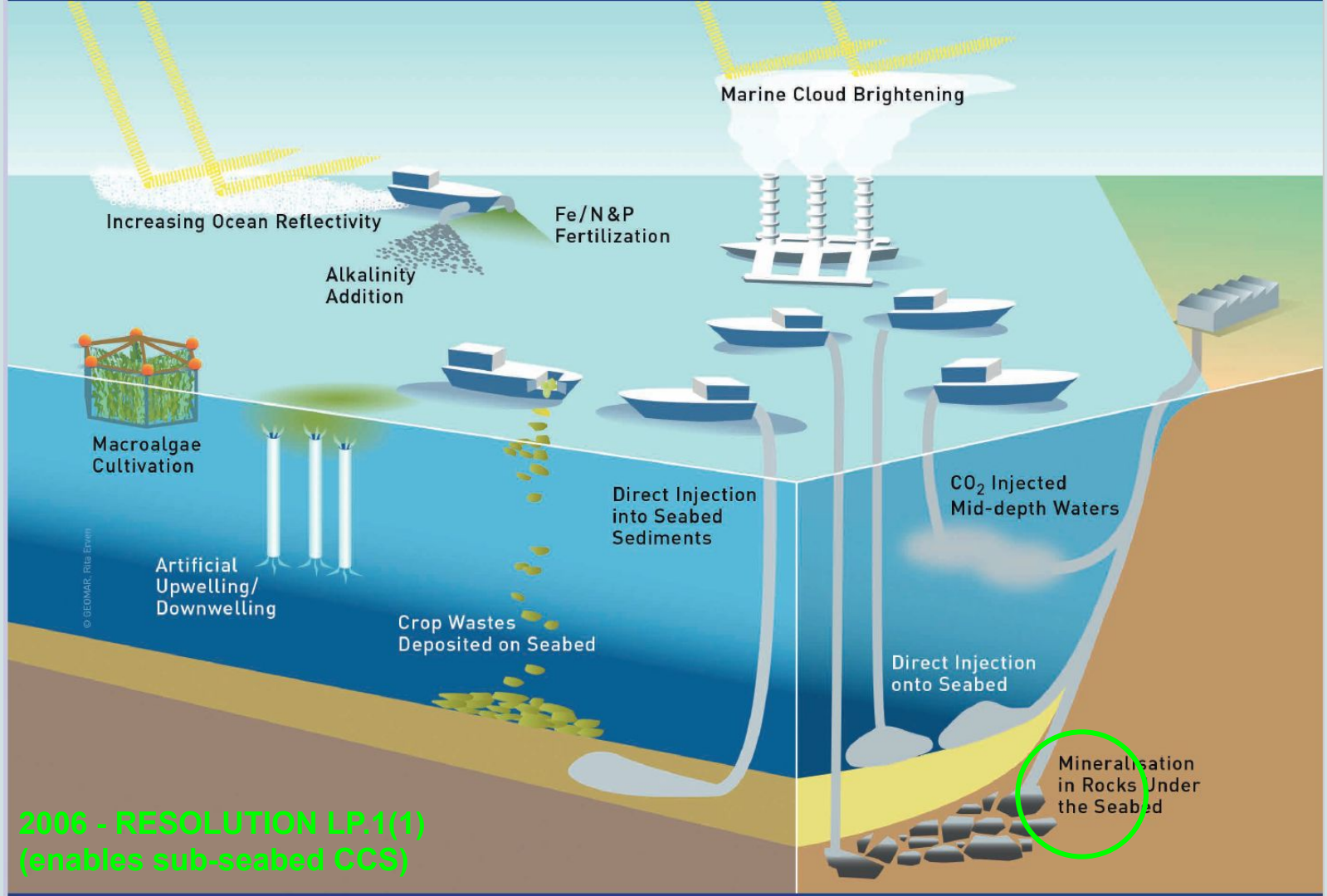
- Marine geoengineering techniques - potential impacts

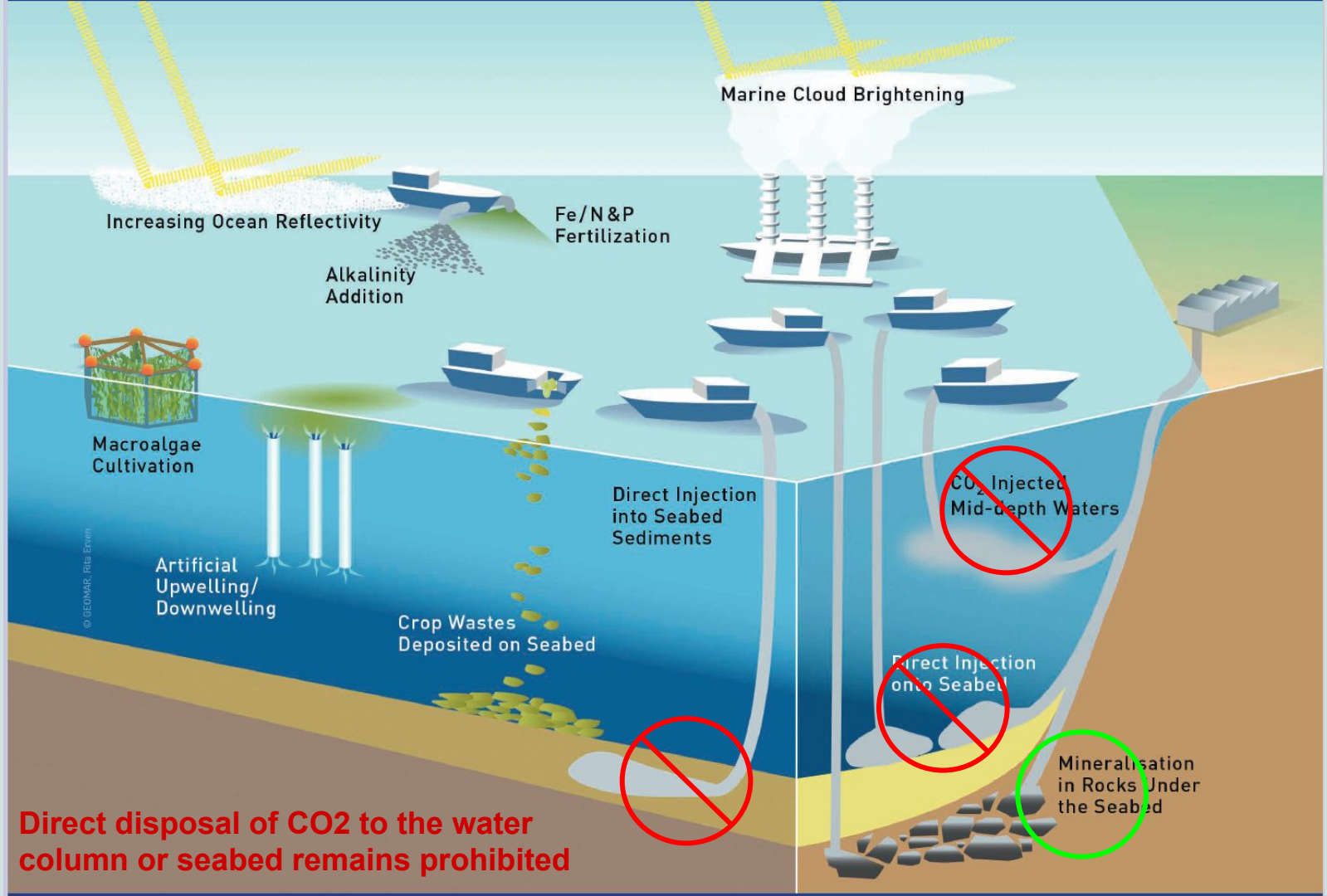
  Link to IMO press briefing on the statement can be found above.

Related Documents

"Marine geoengineering" means a deliberate intervention in the marine environment to manipulate natural processes, including to counteract anthropogenic climate change and/or its impacts, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long lasting or severe."




Marine Cloud Brightening
Increasing Ocean Reflectivity
Fe/N&P
Fertilization
Alkalinity
Addition
Macroalgae
Cultivation
Direct Injection
into Seabed
Sediments
CO_2 Injected
Mid-depth Waters
Artificial
Upwelling/
Downwelling
© GEOMAR, Rita Erven
Crop Wastes
Deposited on Seabed
Direct Injection
onto Seabed
Mineralisation
in Rocks Under
the Seabed
2006 - RESOLUTION LP.1(1)
(enables sub-seabed CCS)


Marine Cloud Brightening
Increasing Ocean Reflectivity
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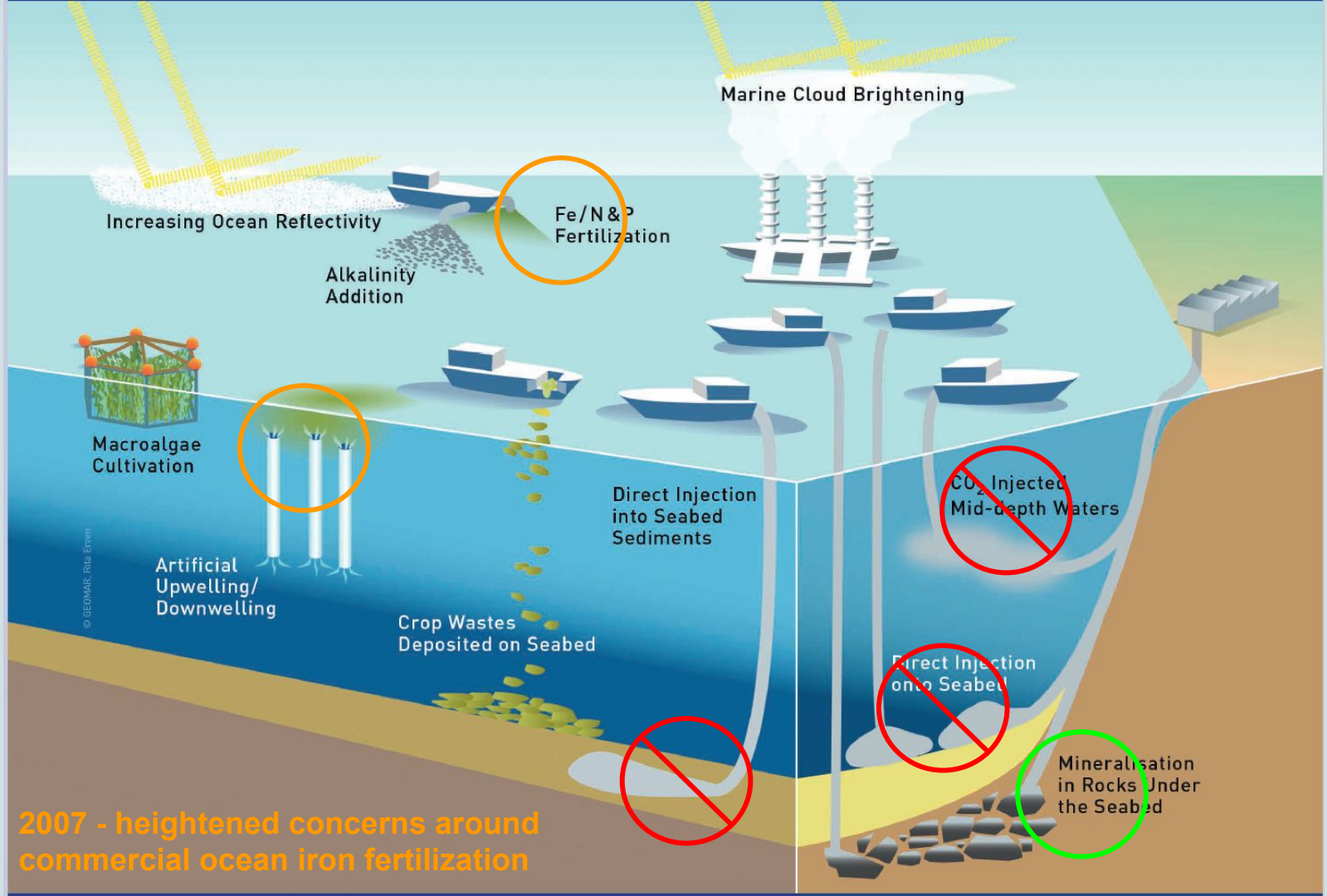
Alkalinity Addition
Macroalgae Cultivation
Direct Injection into Seabed Sediments
CO_2 Injected Mid-depth Waters
Artificial Upwelling/ Downwelling
Crop Wastes Deposited on Seabed
Direct Injection onto Seabed
Mineralisation in Rocks Under the Seabed
© GEOMAR, Rita Erven
Direct disposal of CO2 to the water column or seabed remains prohibited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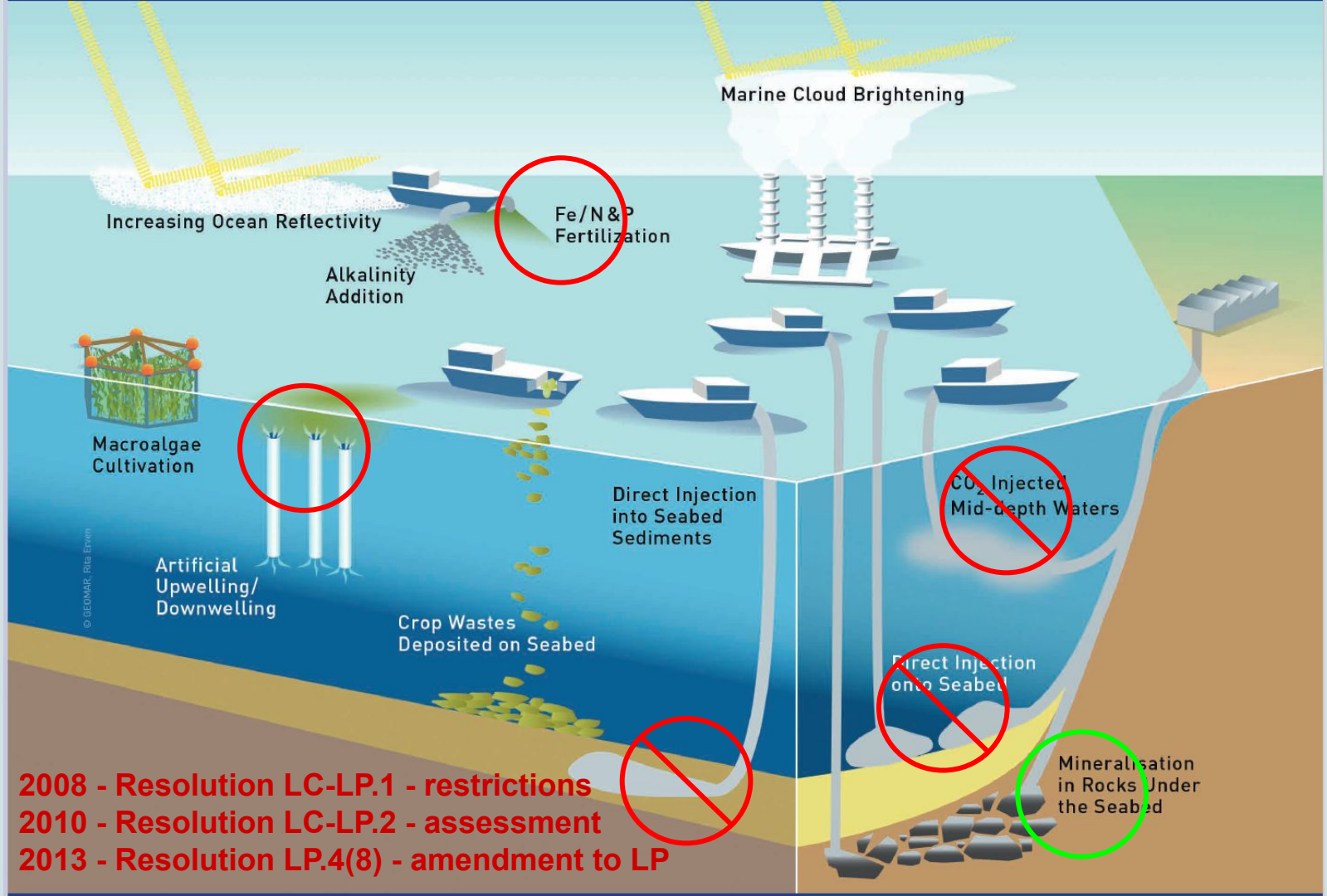
2007 - heightened concerns around commercial ocean iron fertilization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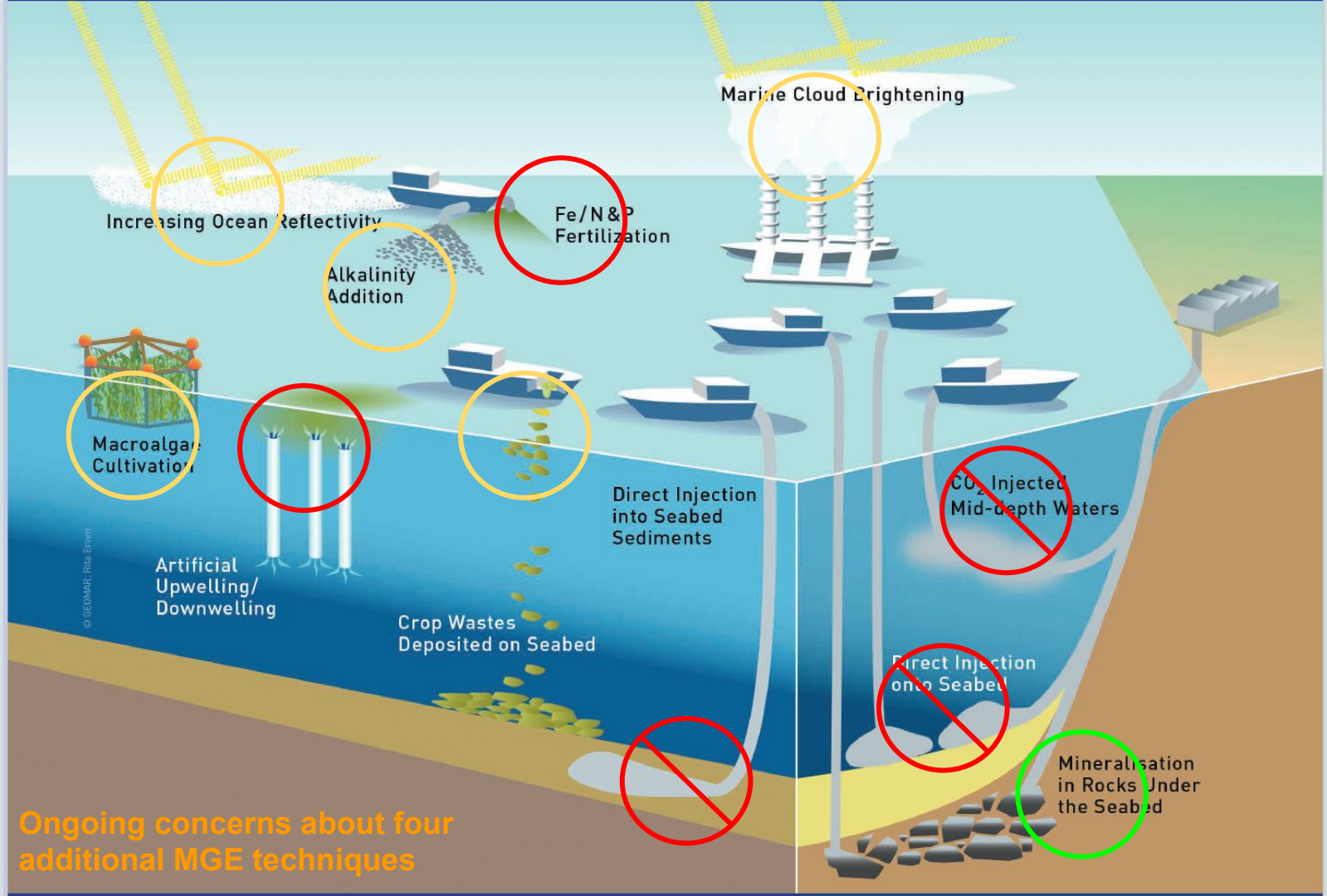
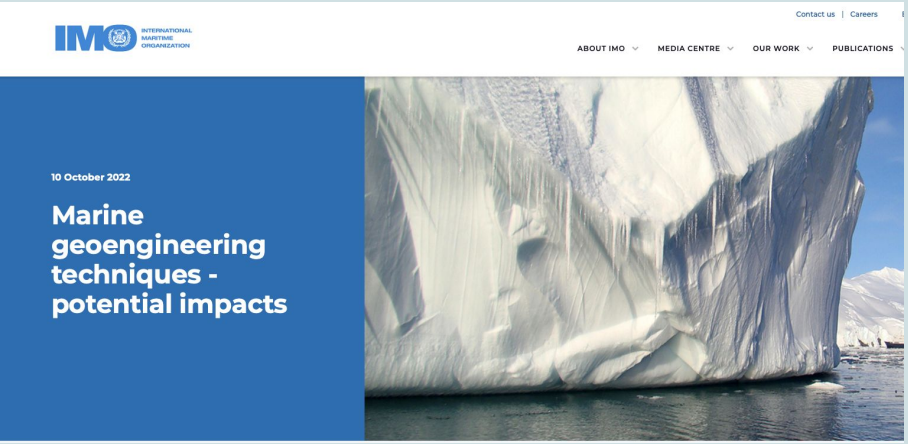
2008 - Resolution LC-LP.1 - restrictions
2010 - Resolution LC-LP.2 - assessment
2013 - Resolution LP.4(8) - amendment to LP



Ongoing concerns about four additional MGE techniques

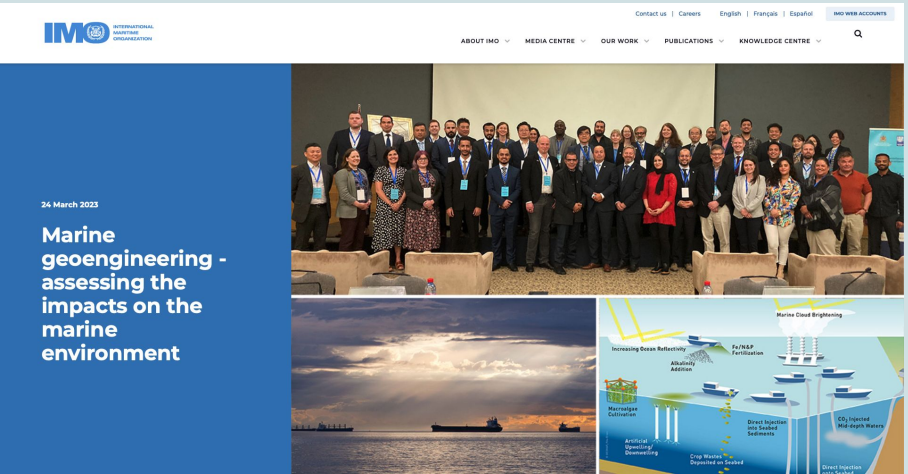
October 2022: LC-LP Governing Bodies - *commitment to priority evaluation of 4 additional techniques*



Parties to the treaties which regulate the dumping of wastes at sea have adopted a statement identifying the need to carefully evaluate marine geoengineering techniques, which may have potential for mitigating the effects of climate change but may have adverse impacts on the marine environment.

The statement identifies four techniques which need priority evaluation, involving either carbon dioxide removal (CDR) or solar radiation modification (SRM).

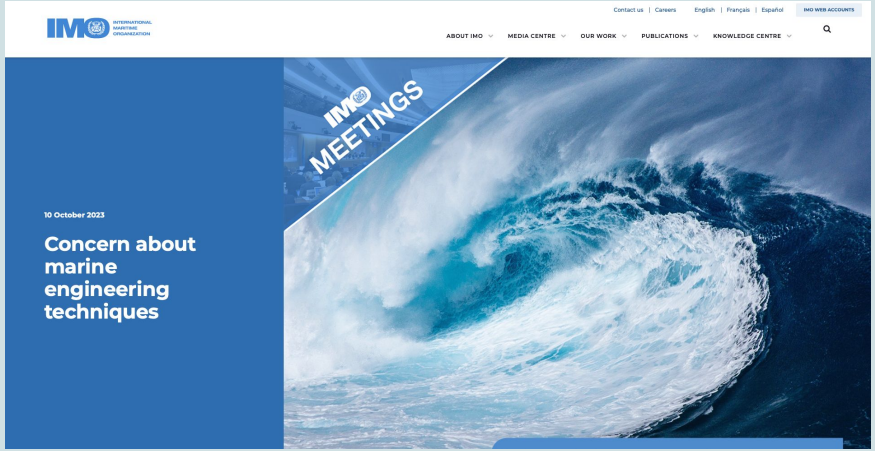
March 2023: LC-LP Scientific Groups - *confirmation that all 4 have the potential to cause pollution*



The Scientific Groups which report to the Parties to the treaties which regulate the dumping of wastes at sea (London Convention and Protocol or LC/LP) agreed at their 2023 meeting (13-17 March) that four marine geoengineering techniques, identified in a statement on marine geoengineering adopted by the treaties' governing bodies in 2022, have the potential to cause deleterious effects that are widespread, long-lasting or severe.

The four marine geoengineering techniques involve either carbon dioxide removal (CDR) or solar radiation management (SRM): ocean alkalinity enhancement and electrochemical CDR; biomass cultivation for carbon removal; marine cloud brightening; and surface albedo enhancement involving reflective particles and/or other materials.

October 2023: LC-LP Governing Bodies - *endorsement of scientific concerns plus a first policy steer*



Parties to the treaties which regulate the dumping of wastes at sea have reiterated, in a statement, their concern about marine engineering techniques, which have the potential for deleterious effects that are widespread, long-lasting or severe.

They state that such marine geoengineering activities, other than legitimate scientific research, should be deferred.

STATEMENT ON MARINE GEOENGINEERING 2023

This statement builds on the work on marine geoengineering carried out so far by the following:

- the governing bodies of the London Convention and London Protocol (including their statement from October 2022);[1]
- the Scientific Groups to the London Convention and London Protocol (including their statement from March 2023);[2] and
- the resolutions adopted by these bodies on marine geoengineering to date (resolutions adopted in 2008,[3] 2010[4] and 2013[5] including the 2013 resolution adopting the amendment to the London Protocol to regulate marine geoengineering.

The governing bodies of the London Convention and London Protocol, mindful of the precautionary approach outlined in article 3 of the LP, endorse the conclusions of the Scientific Groups that:

- each of the four marine geoengineering techniques prioritized for evaluation has the potential for deleterious effects that are widespread, long-lasting or severe; and
- there is considerable uncertainty regarding their effects on the marine environment, human health, and on other uses of the ocean.

Marine geoengineering techniques include both marine carbon dioxide removal and solar radiation management. The four techniques evaluated are ocean alkalinity enhancement; biomass cultivation for carbon removal; marine cloud brightening; and surface albedo enhancement involving reflective particles and/or other materials.

The LC and LP Parties are continuing to evaluate options for appropriate action, including the applicability of the existing frameworks[6] of LC and LP and potential further regulation.

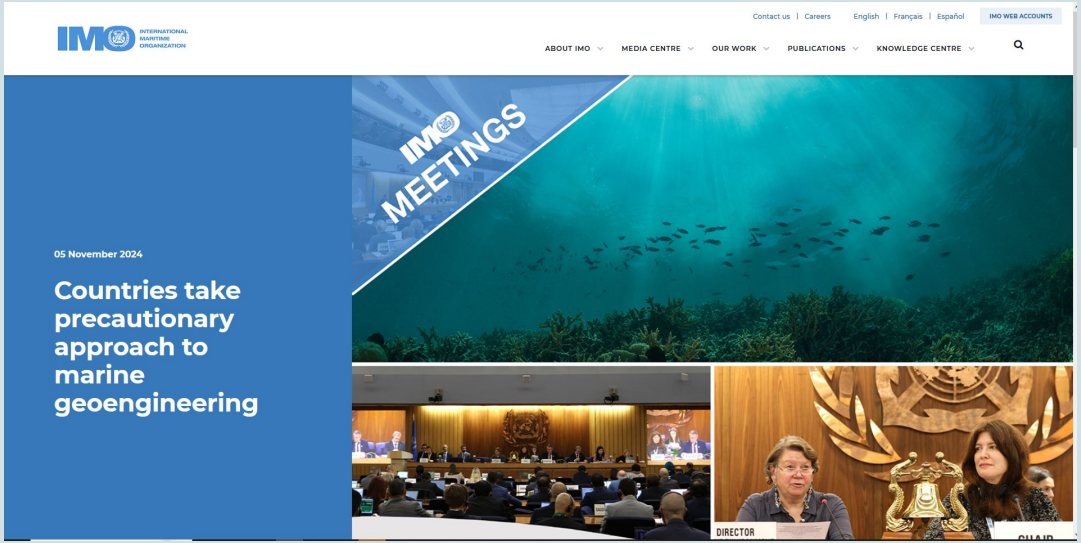
The governing bodies reiterate the urgency of this work against the background of the rapidly growing interest into marine geoengineering techniques and the number and diversity of marine geoengineering projects that have either been conducted, are currently being undertaken or are planned for the future and that in some cases are being driven by commercial interests.

In addition, the governing bodies are of the view that there are risks of adverse environmental impacts of these techniques with limited knowledge of their effectiveness, and as such activities other than legitimate scientific research should be deferred.

The governing bodies are of the view that the requirements set out in the Assessment Framework for Scientific Research Involving Ocean Fertilization[7] and the Assessment Framework for Matter that May be Considered for Placement Under annex 4, as applicable, including criteria for legitimate research, form the appropriate basis for the assessment of proposed research and development projects relating to marine geoengineering, and strongly encourage their application thereof.

Furthermore, the governing bodies of the London Convention and London Protocol encourage Parties to the United Nations Framework Convention on Climate Change (UNFCCC), and the Paris Agreement, the Convention on Biological Diversity, signatories to the Agreement under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ Agreement), bodies thereof as well as other relevant bodies such as the United Nations Environment Programme (UNEP) and the United Nations Environment Assembly (UNEA) to take the work by the LC/LP on marine geoengineering into account, under their respective mandates, including to address climate change. The governing bodies of the London Convention and London Protocol also invite active cooperation with all those bodies that are working on issues to which marine geoengineering, and geoengineering more broadly, are of direct relevance.

October 2024 - LC-LP Governing Bodies reaffirm precaution in work towards regulation…



"Parties to the London Convention and London Protocol have identified four marine geoengineering techniques for further analysis, ***to ensure that ocean-based measures to mitigate climate change prioritize the protection of the marine environment.***"

UN environment programme

CBD/COP/DEC/16/22

Distr.: General
1 November 2024

Original: English

Convention on Biological Diversity

Conference of the Parties to the Convention on Biological Diversity
Sixteenth meeting
Cali, Colombia, 21 October–1 November 2024
Agenda item 25
Biodiversity and climate change

Decision adopted by the Conference of the Parties to the Convention on Biological Diversity on 1 November 2024

16/22. Biodiversity and climate change

6. *Reaffirms* decision IX/16 C on ocean fertilization, paragraph 8 (w) of decision X/33 on biodiversity and climate change and decisions XI/20 and XIII/14 of 9 December 2016 on climate-related geoengineering, and urges Parties, and encourages other Governments, to ensure their implementation;

RUNNING TIDE

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Restore the Climate.
Heal the Ocean.

Carbon removal through ocean alkalinity enhancement

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We can block it.

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By spreading a thin layer of reflective glass beads that function ecologically like sand over key portions of the Arctic, Arctic Ice Project can protect young ice through the summer and stop the feedback loop of melting long, allowing strong, reflective, "old ice" to form. This technology could provide the world with up to 15 years to decarbonize.

IMO INTERNATIONAL MARITIME ORGANIZATION

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SCIENTIFIC GROUP OF THE LONDON CONVENTION – 48th Meeting; and
SCIENTIFIC GROUP OF THE LONDON PROTOCOL – 19th Meeting
10 to 14 March 2025
Agenda item 3

LC/SG 48/3/4
10 January 2025
ENGLISH ONLY
Pre-session public release: ☒

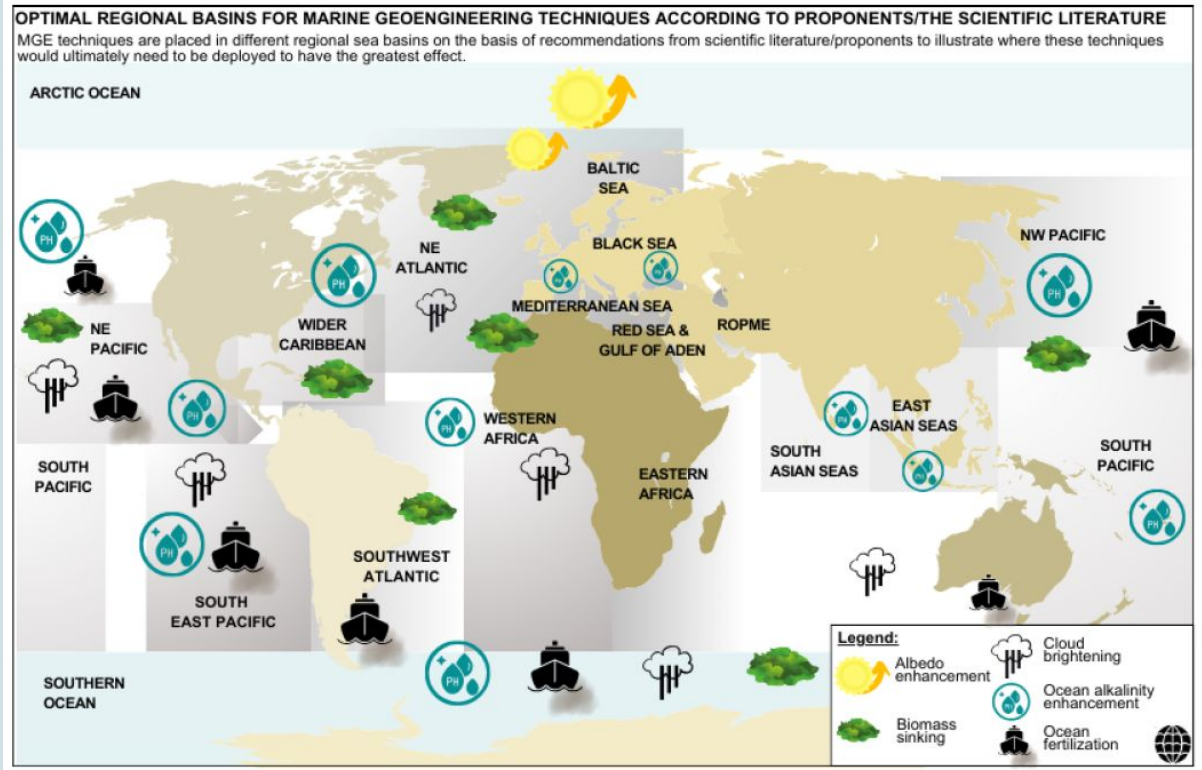
MARINE GEOENGINEERING

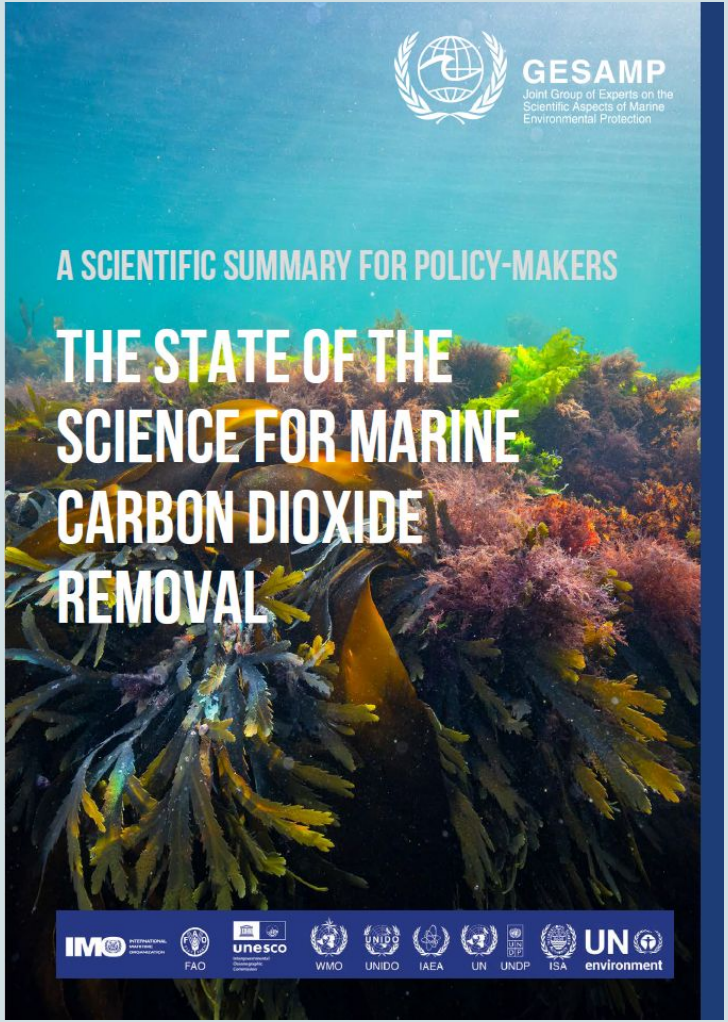
Marine geoengineering research activities and interests are not restricted to the Global North

Submitted by Friends of the Earth International (FOEI), Advisory Committee on Protection of the Sea (ACOPS) and Greenpeace International

Table 1: Overview of marine geoengineering field research activities in Central America, Mexico and the Caribbean

Location of field trial activities	Activities	Company
Antigua and Barbuda	SeaGen's co-founder reports a 49-year lease on 500 square kilometres of ocean in Antigua's EEZ to conduct seaweed biomass sinking trials using an autonomous marine robot.	SeaGen (United Kingdom)
Antigua and Barbuda, Dominican Republic, Mexico and Puerto Rico	Conducted a field trial in seaweed biomass sinking aboard a Dominican Republic Navy ship using a centrifugal pump to pump seaweed to depths (Gray 2021). Reports having deployed Sargassum seaweed collection technology (without sinking at sea) in Antigua and Barbuda, the Dominican Republic, Mexico, and Puerto Rico.	SOS Carbon (Dominican Republic)
Barbados, Mexico, Saint Vincent and the Grenadines	Established test Sargassum seaweed farms off the coasts of Mexico and St. Vincent. Is planning a "Catch & Grow" Sargassum farm in the Caribbean. Reports permits have been requested for two seaweed biomass sinking test locations off Barbados.	Seafields Solutions (United Kingdom)
Gulf of Mexico	Plans to conduct a biomass sinking field trial in the Orca Basin in the Gulf of Mexico using agricultural byproducts sourced in the United States.	Carboniferous (United States)
Panama	Reports having opened a factory in Panama to construct autonomous "BoatBots" designed to collect and sink Sargassum seaweed in the region.	Pull to Refresh (United States)





	Enhancing the biological carbon pump			Enhancing the chemical carbon sink		
	Microalgae fertilization	Sinking of microalgae or crop waste	Artificial upwelling	Mineral addition	Electrochemical	Direct ocean removal
Durability of carbon storage	10s–1 000s	10s–1 000s	10s–100s	10 000+	10 000+	10 000+
Energy demand [1]	⚡	⚡–⚡⚡	⚡	⚡⚡–⚡⚡⚡	⚡⚡⚡	⚡⚡⚡
Knowlegde gaps [2]	?	??	??	??	??–???	???
Technical readiness [3]	Medium–high	Medium	Low	Medium	Low	Low
Occurrence and extent of impacts depends on where, how and how much the methods are used						
Marine ecosystems and biodiversity	● ●	● ●	● ● ●	● ●	●	●
Ocean acidification	●	● ●	●	●	●	●
Area use conflicts [4]	●	● ●	● ● ●	● ●	●	●

[1] Can include production and transportation
[2] Based on peer-reviewed research and reflecting uncertainties
[3] For implementation at scale
[4] On land and at sea

● No effect ● Potentially positive effects ● Potentially negative effects

Key messages

- Due to the insufficient rate of emission reductions, there is increasing interest in exploring the potential for carbon dioxide removal in marine environments.
- Marine carbon dioxide removal (mCDR) approaches are still in the early stages of development; many knowledge gaps and uncertainties remain.
- Each mCDR approach comes with trade-offs in terms of durability, energy demand and environmental impact, and would require large ocean areas if considered for large-scale implementation.
- A key challenge is to enhance technical and regulatory monitoring, reporting and verification (MRV) capacities for marine interventions.
- Future implementation of any and all mCDR approaches will require site-specific assessments, robust regulatory frameworks and an approach that balances ocean protection and use.