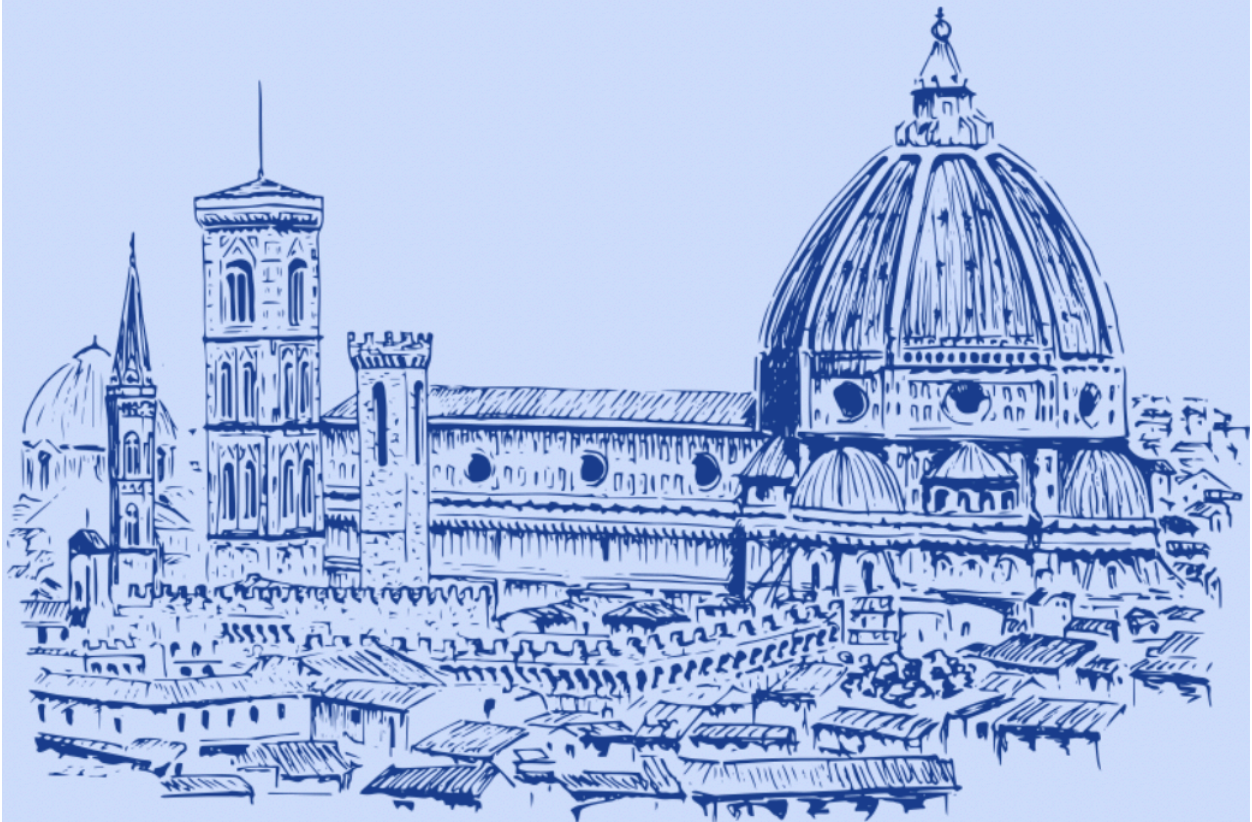


RESEARCH GUIDE

Environmental



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Committee: Environmental Committee

Topic: (1) Combatting ocean acidification as a result of high levels of carbon dioxide emissions

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I. Introduction

The Earth's oceans, once considered vast and resilient, are now facing a critical threat – ocean acidification. This environmental challenge has emerged as a direct consequence of elevated levels of carbon dioxide emissions. As human activities release large amounts of carbon dioxide into the atmosphere, a significant portion is absorbed by the oceans, triggering a complex series of chemical reactions that alter the fundamental properties of seawater. The resulting shift in pH levels poses a severe risk to marine ecosystems, disrupting the delicate balance of underwater life and biodiversity. This issue has gained recognition in recent times, and urgency to address ocean acidification stems from its direct impact on the health and sustainability of marine environments. As the consequences of this environmental dilemma become increasingly evident, there is a growing need for concerted efforts and effective measures to combat and mitigate the detrimental effects of ocean acidification.

II. Definition of Key Terms

1. **pH Levels:** pH is a logarithmic scale that measures the acidity or alkalinity of a solution. In the context of ocean acidification, lower pH values indicate increased acidity, which can have detrimental effects on marine life, particularly organisms relying on calcium carbonate for their structures. The acidification of seawater can disrupt physiological processes in marine organisms, impacting their growth, reproduction, and overall ecosystem dynamics.
2. **Carbon Dioxide (CO₂) Absorption:** Oceans act as a crucial sink for atmospheric carbon dioxide. Increased human activities, such as burning fossil fuels, result in elevated levels of CO₂ being absorbed by seawater. This absorption initiates chemical reactions that alter the carbonate chemistry in the ocean, impacting its overall pH. The continuous rise in carbon dioxide levels contributes not only to ocean acidification but also to global climate change, making it a dual threat to marine and terrestrial ecosystems.

3. **Calcium Carbonate Saturation:** The ability of seawater to maintain a sufficient concentration of calcium carbonate for marine organisms to build and maintain their skeletons and shells. Decreased saturation levels, a consequence of ocean acidification, can hinder the growth and survival of calcifying organisms. As saturation levels decrease, the risk of dissolution of existing carbonate structures increases, threatening the integrity of coral reefs and impacting the fisheries that depend on these ecosystems.

4. **Bicarbonate Ion:** Formed through the reaction of carbon dioxide with water, bicarbonate ions play a crucial role in the buffering capacity of seawater. This buffering helps to mitigate drastic changes in pH, providing a degree of stability for marine ecosystems. The availability of bicarbonate ions influences the resilience of marine organisms to pH fluctuations, with implications for their ability to adapt to ongoing environmental changes.

5. **Marine Calcifying Organisms:** These organisms, including corals, mollusks, and certain types of plankton, rely on calcium carbonate to construct their skeletons or shells. Ocean acidification poses a threat to these organisms as it can hinder their ability to produce and maintain these protective structures. The cascading effects of the impact on calcifying organisms extend to entire marine food webs, influencing the abundance and distribution of various species.

6. **Oceanic Carbonate System:** The complex chemical equilibrium involving dissolved carbon dioxide, bicarbonate, carbonate ions, and other related compounds in seawater. Changes in this system, driven by increased carbon dioxide levels, have widespread implications for marine chemistry, affecting the health and composition of oceanic ecosystems. Understanding this system is fundamental to grasping the multifaceted impacts of ocean acidification. The interconnected nature of the oceanic carbonate system underscores the need for a holistic approach to address the complex challenges posed by rising carbon dioxide levels in the oceans.

III. General Overview

- a) The escalating levels of carbon dioxide emissions have given rise to a pressing environmental concern – ocean acidification. This phenomenon is a direct consequence of the oceans absorbing excess carbon dioxide from the atmosphere, triggering a series of chemical reactions that alter the fundamental properties of seawater. The impact of ocean acidification on marine ecosystems is profound, jeopardizing the delicate balance of aquatic life and biodiversity. As the urgency to address this issue intensifies, there is a growing need for comprehensive strategies and policies to combat and mitigate the detrimental effects of ocean acidification.

b) Historical Background

The historical narrative of ocean acidification traces back to the rapid industrialization of the 19th century when human activities began releasing unprecedented amounts of carbon dioxide into the atmosphere. The subsequent absorption of this excess carbon dioxide by the oceans initiated a process that gradually altered the chemical composition of seawater. Unlike the tangible developments in military technology, the historical progression of ocean acidification is marked by the gradual recognition of its consequences rather than intentional advancements. The parallels lie in the unintended consequences of human actions, echoing the unintended militarization of technologies.

c) Current State of Ocean Acidification

In the present era, ocean acidification has become a global concern with widespread implications for marine ecosystems. The increasing acidity of seawater poses significant threats to marine life, particularly organisms relying on calcium carbonate for their structures. Coral reefs, mollusks, and various plankton species face challenges in maintaining their skeletons and shells. The repercussions extend beyond marine biology, affecting fisheries, coastal economies, and the overall health of the oceans.

d) Environmental Impacts

Ocean acidification's far-reaching consequences include disruptions to marine food webs, altered species distribution, and compromised resilience of marine organisms to other environmental stressors. The intricate balance of oceanic ecosystems is under threat, demanding urgent attention to mitigate the adverse effects. Addressing ocean acidification requires navigating through complex ethical considerations, as well as international cooperation to implement effective measures.

e) Mitigation and Adaptation Strategies

Efforts to combat ocean acidification focus on reducing carbon dioxide emissions, implementing sustainable practices, and developing strategies to enhance the resilience of marine ecosystems. Mitigation and adaptation strategies are essential to minimize the impacts of ocean acidification and protect vulnerable marine species.

f) Global Concerns and Future Perspectives

As ocean acidification continues to manifest as a critical environmental challenge, it raises global concerns about the well-being of marine ecosystems and their crucial role in maintaining planetary health. Just as the militarization of technologies has sparked international debates, the need for collaborative, cross-border efforts to address ocean acidification is imperative. Balancing the imperative for economic activities with the preservation of oceanic health is a challenge that necessitates global cooperation, echoing the complex discussions surrounding the use of military technologies.

IV. Major Parties Involved and their Views

a) China:

As the world's largest carbon dioxide emitter, China's industrial activities, including coal-fired power plants and manufacturing, contribute significantly to elevated atmospheric CO₂ levels. The substantial release of carbon dioxide intensifies the process of ocean acidification, particularly in the coastal waters surrounding China. The country's commitment to combating ocean acidification involves a comprehensive approach, addressing both emissions reduction and sustainable resource management.

b) United States (USA):

The United States, with its extensive industrial and transportation sectors, is a major contributor to global carbon dioxide emissions. The combustion of fossil fuels, deforestation, and industrial processes release large amounts of CO₂ into the atmosphere. The United States, with significant coastlines on the Atlantic and Pacific Oceans, recognizes the importance of addressing ocean acidification. Governmental agencies, particularly the National Oceanic and Atmospheric Administration (NOAA), actively engage in research to monitor and understand the effects of acidification. The USA emphasizes the role of accurate information in guiding policy decisions to protect marine life.

c) Australia:

Australia, another significant emitter per capita, faces the consequences of its coal-intensive energy sector. The combustion of coal releases substantial amounts of CO₂, contributing to the acidification of the surrounding oceans, particularly the Great Barrier Reef. The Australian government's efforts to combat ocean acidification involve research initiatives to understand local impacts and the development of adaptive strategies.

d) Iran:

Iran, although not among the top global carbon emitters, contributes to ocean acidification through its industrial activities and energy production. The use of fossil fuels and the associated emissions add to the global carbon burden.

e) Russia:

As a major global player with extensive land and maritime territories, Russia's industrial activities, including energy production and transportation, contribute to carbon dioxide emissions. The country's reliance on fossil fuels, combined with its vast borders and coastlines, underscores its role in the global carbon cycle. Russia's use of drones for surveillance reflects an awareness of environmental concerns, indicating a potential avenue for addressing emissions and monitoring oceanic conditions.

f) European Union (EU):

While the European Union as a whole has made strides in transitioning to renewable energy, some member countries still rely on fossil fuels. The collective emissions from these nations contribute to global CO₂ levels and, consequently, ocean acidification. The EU's commitment to combating this issue involves collaborative research efforts, emphasizing the need for sustainable practices and emissions reduction across member states.

Addressing ocean acidification requires a concerted global effort, recognizing the varying degrees of responsibility among nations. Mitigating the impact involves not only reducing emissions but also implementing sustainable practices and fostering international collaboration to ensure the health of marine ecosystems worldwide.

V. Relevant UN Documents and Articles

1. United Nations Framework Convention on Climate Change (UNFCCC):

The UNFCCC is the primary international treaty addressing climate change. Ocean acidification is considered a consequence of increasing atmospheric carbon dioxide levels, which is a major aspect of climate change.

<https://unfccc.int/gcse?q=ocean%20acidification>

2. Paris Agreement:

The Paris Agreement, adopted in 2015, is an extension of the UNFCCC and focuses on global efforts to limit global warming. It recognizes the importance of addressing the impacts of climate change on oceans, including ocean acidification.

<https://unfccc.int/process-and-meetings/the-paris-agreement>

3. Sustainable Development Goal (SDG) 14 - Life Below Water:

SDG 14 specifically addresses the conservation and sustainable use of the oceans, seas, and marine resources. Target 14.3 is particularly relevant, calling for minimizing and addressing the impacts of ocean acidification.

<https://www.globalgoals.org/goals/14-life-below-water/>

4. Intergovernmental Panel on Climate Change (IPCC) Reports:

The IPCC periodically releases assessment reports summarizing the latest scientific understanding of climate change. These reports often include information on the impacts of climate change on the oceans, including ocean acidification.

<https://www.ipcc.ch/search/?search=ocean+acidification>

5. World Ocean Assessment (WOA):

The WOA is a UN document that provides a comprehensive assessment of the state of the world's oceans. It includes information on the impacts of climate change and ocean acidification.

<https://www.un.org/regularprocess/sites/www.un.org.regularprocess/files/2011859-e-woa-ii-vol-i.pdf>

6. Ocean acidification International Coordination Centre (OA-ICC):

The OA-ICC, established under the international Atomic Energy Agency (IAEA), serves as a hub for information exchange and coordination of international efforts on ocean acidification. Their reports and publications can provide valuable insights.

<https://www.iaea.org/services/oa-icc>

VI. Questions to Consider

- How do natural processes contribute to ocean acidification, and how do they compare to anthropogenic factors?
- How might ocean acidification impact marine food webs and biodiversity?
- How should responsibilities for mitigating ocean acidification be distributed among countries with varying levels of development?
- How can policymakers balance environmental protection with economic considerations?
- How can technology and innovation contribute to monitoring and mitigating ocean acidification?
- What role do media and educational institutions play in shaping public perception and understanding of this issue?
- How can decision-makers balance short-term economic interests with the long-term sustainability of marine ecosystems?

VII. Conclusion

In summary, ocean acidification, a consequence of escalating carbon dioxide emissions, poses a critical threat to marine ecosystems. Historically rooted in 19th-century industrialization, this global concern now jeopardizes marine life, coastal economies, and overall ocean health. The environmental impacts are profound, affecting food webs, species distribution, and the resilience of marine organisms. Mitigation and adaptation strategies, essential for minimizing these impacts, call for international collaboration and sustainable practices. Key global players, including China, the United States, Australia, Iran, Russia, and the European Union, are recognizing their roles and engaging in efforts to address ocean acidification. The urgency to balance economic activities with oceanic health echoes the complexity of debates surrounding the use of military technologies. The well-being of marine ecosystems emphasizes the need for swift and comprehensive strategies to combat and mitigate the detrimental effects of ocean acidification.

VIII. Bibliography

- 1) Author links open overlay panel J.-P. Gattuso et al. "Effect of Calcium Carbonate Saturation of Seawater on Coral Calcification." *Global and Planetary Change*, Elsevier, 28 Jan. 1999, www.sciencedirect.com/science/article/abs/pii/S0921818198000356#:~:text=The%20saturation%20of%20seawater%20with%20Morse%20and%20Mackenzie%2C%201990.
- 2) Author links open overlay panel Usman Khan et al. "Assessing Absorption-Based CO₂ Capture: Research Progress and Techno-Economic Assessment Overview." *Carbon Capture Science & Technology*, Elsevier, 14 June 2023, www.sciencedirect.com/science/article/pii/S2772656823000295#:~:text=CO2%20capture%20via%20absorption,2%20from%20the%20gas%20mixture.
- 3) Emerson, Steven, and John Hedges. "Carbonate Chemistry (Chapter 4) - Chemical Oceanography and the Marine Carbon Cycle." *Cambridge Core*, Cambridge University Press, <https://www.cambridge.org/core/books/abs/chemical-oceanography-and-the-marine-carbon-cycle/carbonate-chemistry/666E499DD2A4DA30913B6CAF4A823394>
- 4) *How Bicarbonate Is Formed and Its Properties - Echemi*, <https://www.echemi.com/cms/1088194.html>
- 5) "Marine Biogenic Calcification." *Wikipedia*, Wikimedia Foundation, 22 Jan. 2024, https://en.wikipedia.org/wiki/Marine_biogenic_calcification
- 6) *Ocean Acidification | National Oceanic and Atmospheric Administration*, <https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-acidification>
- 7) "Ocean Acidification." *Wikipedia*, Wikimedia Foundation, 19 Jan. 2024, https://en.wikipedia.org/wiki/Ocean_acidification
- 8) "Ph Scale." *pH Scale | U.S. Geological Survey*, <https://www.usgs.gov/media/images/ph-scale-0>