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UNFCCC Ocean and Climate Dialogue

Statement by SilverLining

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Introduction

We congratulate the UNFCCC Co-Facilitators on the UNFCCC Ocean and Climate Change Dialogue and appreciate the opportunity to provide our views on ways forward for further strengthening ocean-based climate action, in particular with respect to the second theme, "Technology needs for ocean-climate action, including finance links."

The recently published UNESCO's *State of the Ocean Report* 2024[1] identifies critical trends indicating that the ocean is warming at twice the rate it was twenty years ago. The warming of the seas now accounts for approximately 40% of the global rise in sea levels. The rate of warming is expected to continue as the ocean absorbs 90% of the excess heat released into the atmosphere, causing water to expand and global sea levels to rise.

2023 saw record global temperatures.[2] A key cause is the increase of greenhouse gases in the atmosphere. Recent studies and discussions among scientists on additional potential drivers of this warming have highlighted changes in pollution aerosols above the world's oceans as a possible significant factor.[3][4]

After greenhouse gases, anthropogenic pollution aerosols represent the second-largest human influence on climate. As both a short-lived influence, and one that is counter to global warming, they are the greatest driver of uncertainty in the amount of future warming and the timing for reaching the 1.5C threshold.[5] Improved and expanded

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[1] See : https://www.ioc.unesco.org/en/stor2024

[2] See: https://www.climate.gov/news-features/featured-images/2023-was-warmest-year-modern-temperature-record

[3] Wang, P., Yang, Y., Xue, D. *et al.* Aerosols overtake greenhouse gases causing a warmer climate and more weather extremes toward carbon neutrality. *Nat Commun* 14, 7257 (2023). https://doi.org/10.1038/s41467-023-42891-2; Yuan, T., Song, H., Oreopoulos, L. *et al.* Abrupt reduction in shipping emission as an inadvertent geoengineering termination shock produces substantial radiative warming. *Commun Earth Environ* 5, 281 (2024). https://doi.org/10.1038/s43247-024-01442-3

[4] Wang, H. et al Atmosphere teleconnections from abatement of China aerosol emissions exacerbate Northeast Pacific warm blob events. *PNAS, 121 (21) (2024)* https://www.pnas.org/doi/10.1073/pnas.2313797121

[5] Li, J., Carlson, B.E., Yung, Y.L. et al. (2022). Scattering and absorbing aerosols in the climate system. *Nat Rev Earth Environ.* V. 3: 363–379 https://doi.org/10.1038/s43017-022-00296-7

observations of aerosols in the marine atmosphere would provide data that reduces scientific uncertainty regarding the effects of marine aerosols on clouds and climate, improving climate projections and informing decisions on responses to climate change. Aerosols and their interactions with clouds are challenging to observe, requiring sophisticated instruments and in-situ as well as satellite measurements. Greenhouse gas exchanges between the ocean and atmosphere are also sparsely measured and critical to inform climate projections and ocean-climate solutions. Given these factors, this is an essential topic under the Ocean-Climate Dialogue.

Noting the above, there is an urgent need for technology and the establishment of a wide network of observations of the marine atmosphere to further strengthen ocean-based climate action.

Improving technology to support ocean-based observation networks

International efforts supporting ocean-climate action would benefit greatly from substantial investments in technology to support ocean-based observations with a focus on marine aerosols.[6] Atmospheric monitoring capabilities face major gaps in their ability to characterize the present-day composition of the atmosphere. Among these are large observation gaps over the oceans, which covers approximately 70% of the Earth's surface. Improving technology to support ocean-based observation networks will greatly improve the scientific information about the Earth’s ocean, climate, and atmosphere that is available to inform international ocean and climate policies.

Anthropogenic aerosols are tiny particles released into the atmosphere as a result of human activities such as burning fossil fuels, industrial processes, and agricultural practices. These aerosols are often co-emitted with greenhouse gases during the combustion of fossil fuels in energy sources such as marine fuels.

Unlike other emissions, anthropogenic aerosols have an overall cooling effect on the climate. This cooling effect arises from their ability to scatter sunlight and affect the distribution, lifetime and reflectivity of clouds, leading to a reduction in the amount of solar radiation reaching the Earth's surface. However, their cooling effect is outweighed in the long term by the warming caused by co-emitted greenhouse gases like carbon dioxide. Anthropogenic aerosols also cause significant health and environmental harms, such as by contributing to air pollution and harming ecosystems. For this reason, environmental and health regulations are reducing aerosol levels over time.

[6] G Persad et al 2023 *Environ. Res.: Climate.* V.2: 032001. https://doi.org/10.1088/2752-5295/acd6af

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Marine cloud brightening

Interventions in the climate system to reduce warming by increasing the reflection of sunlight from clouds and particles in the atmosphere may provide options for protecting the safety of the world's people and the stability of its natural systems while society reduces greenhouse gas emissions and transitions to a sustainable future. One such proposed climate intervention is called marine cloud brightening.

Scientific studies indicate that aerosols of the right size and concentration could significantly increase the reflectivity of specific types of clouds. This phenomenon is visible in satellite images of clouds brightened by ship emissions (known as "ship tracks"). Observations of ship tracks led scientists to the idea of using particles of salt from sea water, a natural source of cloud-forming aerosol particles, to brighten clouds over parts of the ocean in order to reduce climate warming.

Small-scale atmospheric release studies are necessary to inform model projections of the impacts of emissions at larger scales, providing information on the atmosphere and climate. Accordingly, these studies are also essential for evaluating marine cloud brightening to inform policy makers.

Reports from UNEP[7], UNESCO[8], the United States[9], Canada[10], and the EU[11] and new initiatives such as the World Climate Research Program's Lighthouse Activity on Climate Intervention, call for increased research on and assessment of climate interventions like marine cloud brightening to support international decision making.

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[7] United Nations Environment Programme (2023). *One Atmosphere: An independent expert review on Solar Radiation Modification research and deployment*. Kenya, Nairobi.
[8] World Commission of UNESCO on the Ethics of Scientific Knowledge and Technology. (2023). *Report of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) on the ethics of climate engineering*. Paris: UNESCO.
[9] OSTP. (2023). Congressionally Mandated Research Plan and an Initial Research Governance Framework Related to Solar Radiation Modification. Office of Science and Technology Policy, Washington, DC, USA.
[10] Environment and Climate Change Canada. (2024). 2024 - 2029 Science Strategy. Environment and Climate Change Canada, Quebec, CA.
[11] European Commission and High Representative of the Union for Foreign Affairs and Security Policy. (2023). Joint Communication to the European Parliament and the Council. https://www.eeas.europa.eu/sites/default/files/documents/2023/JOIN_2023_19_1_EN_ACT_part1_v7.pdf

Additionally, decisions[12] adopted by the Convention on Biological Diversity recognize the value of small-scale research studies and call for increased transdisciplinary research in this area.

Support to the Global South

There exists a parallel urgent need for enhanced technical and financial capacity by scientists in the Global South to participate equitably in research on atmospheric aerosols and marine observations. The lack of scientific capacity has its origins in the difficulty faced by Global South to quickly access resources for scientific personnel and tools, funding for researchers, infrastructure for data, and substantial computing capacity, including access to cloud computing. The complexity of the problem increases given that the computing and related technical expertise required for marine climate research is among the greatest in any area of human endeavor and requires both substantial funding and access to advanced computing capabilities.

However, overall resources for these activities are extremely limited. The financial mechanisms that are available for work in these areas are time-consuming, onerous, and often require developing countries to seek Northern consulting expertise in the drafting of proposals. Additionally, the funding available under such mechanisms is submitted to national ministries as opposed to targeting the scientific community directly, causing delays in the development and implementation of scientific projects and programs.

Finally, computing resources are not generally part of any programs and lead to Global South marine researchers taking student and professional postings in Global North countries to access adequate capabilities for climate research. The marine research supported in this may not be relevant to the priorities and needs of the Global South researchers' country of origin.

Recommendations

Below are recommendations on contributing to the enhancement of ocean-based observations and studies of marine aerosols and their effects to support rapid improvement in projecting and responding to climate change:

[12] For example, CBD Decision XIII/14, paragraph 5 states: *Also notes that more transdisciplinary research and sharing of knowledge among appropriate institutions is needed in order to better understand the impacts of climate-related geoengineering on biodiversity and ecosystem functions and services, socio-economic, cultural and ethical issues and regulatory options;*

A. Urgently increase investment in technologies to improve research on marine aerosols, including to address topics such as:
    i. Baselines of, and sustained monitoring capabilities for, key aerosol processes and populations across seasons and hemispheres in the marine boundary layer;
    ii. How interactions between aerosols and clouds impact our climate system;
    iii. How aerosol particles in the atmosphere from both natural sources (such as biological emissions and sea spray) and human activities (such as from burning fossil fuels, wood and vegetation) mix into low clouds over the ocean to affect climate;
    iv. How aerosols effects contribute to climate forcing overall;
    v. How the expansion of air quality regulations and resulting decline in atmospheric aerosols influence global warming; and,
    vi. Evaluating the potential risks and benefits of marine cloud brightening and its potential to reduce the risks and impacts of climate warming.
B. Urgently increase financial support to scientists in the Global South by:
    i. Developing an innovative funding mechanisms based on successful models offered by the Inter-American Institute for Global Change Research and the Montreal Protocol Multilateral Fund;
    ii. Developing funding mechanisms that are dedicated to physical sciences research on climate change and are co-led and accessed by the scientific community in the Global South;
    iii. Focusing financial support to allow scientists in the Global South to improve infrastructure for data, and access substantial computing capacity, including access to cloud computing; and,
    iv. Promote equitable participation in projects on marine aerosols and MCB by the scientific community in the Global South.