# Thinking outside the ocean-climate nexus: Towards systems-informed decision making in a rapidly changing world

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**Abstract: Despite repeated calls for more inclusive practices, approaches used to address current challenges within the ocean-climate nexus do not sufficiently account for the complexity of the human-social-ecological system. So far, this has prevented efficient and just decision-making and policies. We propose to shift towards systems-informed decision making, which values transdisciplinary system-thinking and cumulative impact assessments, and encourages multi-system collaboration among decision-makers in order to address the recuring technicality of policies and to foster just solutions that account for the needs of varied actors across the sustainable development spectrum.**

**Introduction:**

On March 4, 2023, following decades of negotiation, states agreed on the text of a 'High Seas Treaty' celebrated as a "historic agreement on protecting marine biodiversity in international waters" (UN News, 2023). Throughout the negotiations and within the final treaty, climate change is identified as a principal stressor on the ocean while the ocean's role in carbon cycling services is highlighted. Following the diplomatic success of the Treaty finally being agreed, it is important to recognise that there is more to come, with the implementation phase expected to be equally challenging, and "more ambitious measures will be needed" (IUCN, 2023).

In response to the growing calls for urgent action to address current and future ocean challenges, the scientific community has called for an approach to the ocean-climate nexus that is more transdisciplinary and inclusive (Minas, 2019; Udo, Prior and Seck, 2022). System-thinking has been proposed as a way to "robustly consider the interconnected world we live in and move away from a 'siloed' approach to policy" (Bache and Reynolds, 2022). However, translating these aspirations into policies is challenging. Indeed, despite an official narrative that suggests an understanding of these needs (e.g. Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), High Level Panel Blue Papers), policies are still very much technical, and problems and needs of minority actors at the ocean-climate nexus often remain marginalized in practice. Recent efforts have been made to more meaningfully incorporate the global south, especially vulnerable and developing communities (IPCC AR6, SROCC), yet attention to deeper human psychosocial dimensions of addressing climate change and associated ocean and coastal challenges continue to remain overlooked (World Bank, 2019; Fankhauser, de Menezes & Opacic, 2019; Tam, Leung & Clayton, 2021).

The UN Ocean Decade Global Stakeholder Forum has stressed the importance of developing a better understanding of the ocean-climate nexus to devise solutions to mitigate and adapt to climate change. While biophysical aspects are essential, we argue that, as we enter the age of implementation of climate action, we must consider the systems that impact, and are impacted by, physical and policy

changes across the spectrum of the ocean-climate nexus. Despite aspirations to the contrary, initiatives like the United Nations Decade of Ocean Science for Sustainable Development (UN Ocean Decade), the United Nations Framework Convention on Climate Change (UNFCCC), and the United Nations Convention on Biodiversity (UNCBD) remain situated around the same approach; one that is technical (technology-focused and managerial) and does not yet adequately account for the complexity of the human-social-ecological system, thus preventing just and efficient decision-making.

To overcome these current issues and encourage a step change in devising efficient solutions, we need to address these shortcomings to deliver more effective and sustainable policy-making outcomes and achieve existing policy goals (e.g., 30 by 30 or Net Zero) (House of Lords, 2023; Fankhauser et al., 2023). To respond to the twin biodiversity and climate crises, there is an urgent need to adopt an ocean-climate approach that abandons the biophysical-driven decision-making paradigm, which has dominated ocean decision-making, in favour of systems-informed decision-making that recognises the ocean as a complex socio-ecological system (Bennett, 2022; Germond-Duret, 2022; Kelly, 2022).

Informed by expertise in environmental and marine politics, human geography, marine social sciences, climate impacts, and marine biology, and drawing on insights from author participation in the UNFCCC process, this Comment suggests three elements that, on their own and together, contribute to a systems-informed approach to ocean and climate decision-making: 1) transdisciplinary system-thinking to address the technicality of current policies and foster inclusive practices, 2) cumulative impact assessment to systematically account for the complex synergies between earth and human factors, and 3) multi-system collaborative decision-making to give a voice to minority stakeholders.

**1) Transdisciplinary system integrative thinking:**

The call for transdisciplinarity is not new, and the benefits of a system-thinking approach to tackle sustainability challenges are often advocated (Voulvoulis et al., 2022). In spite of enduring dialogue within academic circles, transdisciplinary system-thinking approaches face numerous barriers in

practice (Hynes, Lees & Müller, 2020), meaning global conservation policies have failed to secure healthy oceans, address the impacts of climate change and halt marine biodiversity loss (Chambers, Masarella & Fletcher, 2020). Despite some progress, the rate of biodiversity loss remains high, a third of marine fish stocks are overfished, plastic pollution is accumulating in the oceans, hard coral cover has been significantly reduced, and most ecosystem services are in decline (CBD 2020). The IPBES global assessment concluded that the conservation and sustainability goals for 2030 cannot be met by current trajectories and will only be achieved through transformative changes across economic, social, political, and technological factors (IPBES 2019). However, this ambition has not yet resulted in more integrated and integrative practices.

Without addressing the social and economic factors that are frequently the root causes of ocean degradation, no substantial progress in achieving sustainability goals is expected. Many failures in biodiversity protection can be attributed to omitting people from decision-making processes and a lack of sensitivity to the needs of local communities, particularly in lower income countries (Bennett, 2022; Brockington and Wilkie, 2015; Tilman et al., 2017). Although the crucial nexus between the ocean, climate, and ecosystem services is increasingly recognised (IPBES 2021), effective and meaningful social auditing and stakeholder engagement are commonly missing from ocean governance and planning (Giakoumi et al. 2018). We argue that an integrated socio-ecological approach is urgently needed to assess the human and environmental risks from cumulative global and local pressures, generate innovative ideas for climate mitigation and adaptation, promote adequate nature-based solutions, and engage societal actors in reducing ocean pressures (Visbeck 2018; Lauerburg et al. 2020; McKinley et al., 2022). In summary, we must translate transdisciplinary system-thinking into actionable practices that truly value non-technical and non-mainstream concerns and ideas.

**2) Cumulative socio-ecological impact assessment:**

The effects of climate change act in a synergetic, multiplicative, additive, or even antagonistic way with other local human stressors on the marine environment (Gissi et al., 2020). Acknowledging this complexity, the CBD encourages Member States to evaluate the cumulative effects produced by multi-fold drivers and pressures. Similarly, UNCLOS established a framework for linking activities of economic interest and ecosystems protection, aiming to regulate and control several human activities that could degrade the marine environment.

In answer to these policy calls, cumulative impact assessments have emerged as invaluable tools to conducting holistic evaluations of the interplay between anthropogenic pressures and natural processes that could trace climatic impact pathways to natural and social systems (EPA, 2023). From a methodological perspective, these integrated assessments enable the consideration of multiple social and economic aspects of marine uses, considering a comprehensive review of legislation, policy frameworks, management practices, guidelines, and critical thresholds (Stelzenmüller et al., 2018). Building upon state-of-the-art advancements on assessing climate threats and vulnerability, cumulative impact assessments is a keystone approach for enhancing human and societal engagement with ocean-climate decision-making (Hallowed et al, 2020). For example, this has proved useful to account for the human impacts on marine ecosystem-based management (Loiseau et al., 2021). In summary, cumulative socio-ecological impact assessment is a key method to address the need to account for the complex synergies between physical and societal factors at the ocean-climate nexus. It holds the potential to empower the scientific community in providing policy stakeholders with a more holistic understanding of climate-ocean challenges, ultimately paving the way for the development and implementation of more comprehensive and effective solutions.

**3) Multi-system collaborative decision-making:**

Sociocultural and biophysical complexities and the historical lack of appropriate, integrative approaches have prevented decision-making from addressing the increased impacts of climate change

on ocean systems (Lorenzo & Rysavy, 2021). To address the inherent complexities and interconnectedness within the ocean-climate nexus, it is vital to embrace a multi-system approach to decision-making that accounts for the multiplicity of systems (ocean/climate, natural/social, multistakeholder) and values the unique knowledge that diverse individuals, sectors, and disciplines bring to unique and challenging ocean-climate issues (Crossman et al., 2022).

Multi-system collaborative decision-making accounts for the synergistic links between the impacts of climate change on natural and social systems, calls for dialogue among disciplines and stakeholders, and necessitates decision-makers to engage with issues outside their core system (Fig. 1). For example, Ocean Carbon Dioxide Removal (OCDR), i.e. "activities that use marine processes to remove CO2 from the atmosphere and sequester it for decades or longer" (Cooley et al., 2023, p.42), illustrates a complex techno-socioeconomic situation being explored and negotiated at policy level. There are tensions between the potential biophysical impacts of novel technology-based OCDR propositions on the global ocean and human reliance on ocean ecosystem services (in the context of climate and economic pressures). As biophysical and sociocultural impacts accumulate, multiple sectors and communities are impacted by policy and can, in turn, influence policy-making processes. A multi-system decision-making approach to OCDR would support the development of mutually beneficial solutions that are considerate of the diversity of interests and urgently needs flooding into the artificial OCDR space (Cooley et al., 2023).

In another example, the effects of climate change on ocean ecosystems (e.g., sea level rise, extreme weather events) impact on human systems (e.g., food shortages, poverty, and health – generating resentment and grievance), which can then incentivize maritime crime (e.g., illegal fishing, piracy) (Germond and Mazaris, 2019; Pinsky et al., 2018). The lack of dialogue between decision-makers in charge of addressing the effects of climate change on the global ocean and those in charge of securing the ocean prevents a holistic approach to the security dimension of the ocean-climate nexus. A multi-system approach that accounts for cumulative impacts across natural and social systems would help initiate the necessary dialogue between policy-makers, climate scientists, and maritime security

stakeholders. While there are many other examples, the two discussed here show that, despite featuring in official documents (e.g. SROCC), multi-stakeholder, multi-system collaborative decision-making has yet to be translated into practices that truly account for diverse values, include minority voices and truly focus on problems that are central to communities across the full spectrum of sustainable development.

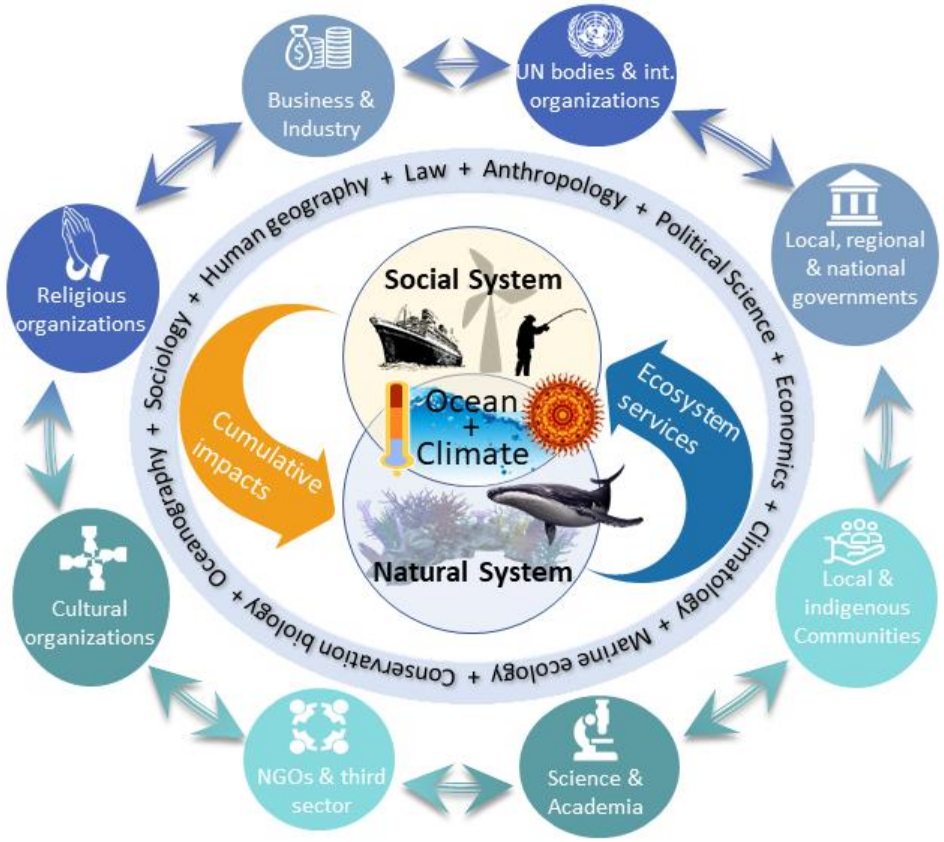


Figure 1: A multi-system approach to ocean-climate decision-making

**Ocean-climate nexus: policy and academic implications:**

While calls for transdisciplinarity and stakeholder engagement in decision-making are not novel (e.g. Katsanevakis et al., 2020), we propose to go beyond these requirements and consider the synergies and connections within and between systems. At policy level, this involves a further integration of competencies and expertise among specialist agencies, an awareness of structural and peripheral interactions between natural and social systems, a dialogue with experts within and outside one's

core remit, the systematic and fair inclusion of stakeholders across the board, and the recognition of contextual specificities (in other words, avoiding 'blanket strategies'). For instance, to achieve the goals of the Kunming-Montreal Global Biodiversity Framework by 2030 and, looking beyond 2030, effectively reflect the complex interactions between ocean, climate, and biodiversity, we urgently need to operationalise this change of approach and shift towards a systems-informed decision making.

Concepts such as eco-system services and marine spatial planning and policy calls for multi-stakeholder, inclusive approaches demonstrate that these considerations are gaining traction. Still, much effort is needed to transform scientific calls that mirror societal needs and challenges into policy objectives that are not only acknowledged or adopted at the higher political levels but implemented at various scales. To that effect, the age of climate action requires us to recognize the centrality of the social systems and the need to engage with social sciences and assess how climate change and climate policy can equally benefit from and impact the ocean.

Foundations for further cooperation between the CBD, the UNFCCC and UNCLOS, within the context of the UN Ocean Decade, need to be laid, and they must be based on the recognition of the connections between systems. Indeed, the High Seas Treaty stresses the need to account for the impacts (and cumulative impacts) of planned activities, including the economic, social, cultural and health impacts. Indeed, considering cumulative impacts as the means to access ocean health, prioritize areas for conservation, determine risk hotspots and spatially delineates zones where selected activities (e.g., fishing) are banded/controlled and actions (e.g., restoration) are promoted, is a practice which is receiving more attention across the globe. The Maritime Spatial Planning Directive of the European Union (2014/89/EE) represents an interesting example of how cumulative impact assessment has gained a role into the policy agenda as a means to deal with spatial use conflicts, further justifying the importance of such a methodological framework. What we need is to capitalize upon the existing state of the art and scientific background and expand the applicability of such approaches across temporal, spatial and administrative scales considering climate change as an inherent source of complexity for properly managing oceans, their exploitation and uses.

Under the High Seas Treaty, states are encouraged to complement scientific assessment with "relevant traditional knowledge of Indigenous Peoples and local communities" (art.30, para 1). Such ambitious objectives can only be achieved through a truly inclusive and transdisciplinary process. Shifting towards systems-informed decision making will enable an effective and just policy implementation of necessarily ambitious objectives that have so far remained principally at the narrative level.

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