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Editorial: Climate risks, resilience and adaptation in coastal systems

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Editorial on the Research Topic
Climate risks, resilience and adaptation in coastal systems

Introduction

Coastal systems in the low-elevation coastal zone (LECZ: up to 10 m from sea level) are subject to sea level rise (SLR), climatic variability (e.g., El Niño Southern Oscillation), and extreme weather events. The impacts caused by these stressors include coastal flooding, storm surges, inundation, loss of habitats, and coastal erosion, which affect the human and natural systems and various socioeconomic sectors, including settlements, infrastructure, tourism, health and natural resource-dependent livelihood (Cooley et al., 2022; Pörtner et al., 2022). Therefore, minimizing/lowering the exposure of socio-ecological systems to potential SLR in the LECZ is particularly critical to ensure sustainable ecosystem functioning and healthy living (Vafeidis et al., 2011).

The coastal systems' resilience is usually enough to cope with and adapt to typical climatic variability. However, given the current climatic trends and projected changes, there is an increasing need to foster their adaptive capacity, enlarge adaptation options, and reduce their exposure and vulnerability to extreme weather events, alongside minimizing the unsustainable practice of resource management to enhance coastal systems' resilience (Sharma and Ravindranath, 2019; Cooley et al., 2022).

To initiate a fresh climate adaptation and preparedness action or to bolster an existing one against the impacts of the climate stressors and perturbations on dynamic coastal socio-ecological systems mentioned earlier, the stakeholders and policymakers must address the following:

1. The climatic, social, and environmental determinants of vulnerability (Bevacqua et al., 2018; Sharma and Ravindranath, 2019).
2. The exposure of diverse geographical, economic, socio-cultural and political factors to climate-related stressors and perturbations (Ara Begum et al., 2022; O'Neill et al., 2022).
3. A climate risk-management approach (vulnerabilities, stakeholders, future scenarios, thresholds, risks, and potential impacts) (Ara Begum et al., 2022).

Contributions to the Research Topic

Building on this concern, the editors of the Topical Collection on "*Climate risks, resilience and adaptation in coastal systems*" analyzed the papers on this Research Topic and are glad to introduce the following five articles (Figure 1) from Australia, Bangladesh, Denmark, the United States, and Venezuela.

Modrakowski et al. analyzed potential extreme events in which the combination of multiple drivers and hazards causes extreme socioeconomic impacts to exposed coastal municipalities vulnerable to flood hazards in Denmark. Expert interviews and analysis of policy documents showed that compound events are understood as a condition or situation. Consequently, municipalities develop precautionary strategies depending on their geographical surroundings. Their findings highlight different bottom-up tailor-made local solutions relying on the broad inclusion of scientific practices, research, creative thinking, and preparedness for effective climate risk management, among others.

Wong et al. explored the projections of extreme sea levels (ESLs) for managing coastal risks based on 36 ESL tide gauge data sets along the East and Gulf coasts of the United States. The data are processed using annual block maxima and peaks-over-thresholds approaches for modeling distributions of extremes. They found that accounting for changes in the frequency of coastal extreme sea levels provides a better fit to data than using a stationary extreme value model. These results affect how deep uncertainties in coastal flood hazards are characterized, particularly how studies incorporate potential non-stationarity in storm surge statistics.

Sultana and Luetz examined Bangladesh's unique resource-rich and vulnerable coastal system. They assessed the value of coastal community engagement in the Bhola and Satkhira districts to increase adaptive capacity in the face of climate change. A total of 240 participants informed this empirical research. Village case studies highlight helpful examples of adaptation initiatives that increase people's capacity to respond to climate change. Water management, socioeconomic conditions, and migration away from coastal districts are some issues flagged for urgent attention. Finally, the article identified Indigenous and local adaptation strategies that government policies may support.

Condie explained that the climate vulnerability and degradation of the Great Barrier Reef in Australia demand effective local interventions evaluated through a risk-based assessment approach for complex ensemble ecological modeling to compare intervention strategies. This approach generates the exposure, sensitivity, adaptive capacity, and impacts in a dynamically consistent form, which estimates them independently and combines them under additional assumptions. Their findings suggest that regional intervention strategies, e.g., solar radiation management and control of coral predators, can slow down the increasing pace of risk and potentially avoid future extreme risks.

Olivares-Aguilar et al. reviewed and applied approaches to assessing climate vulnerability and cumulative coastal environmental impacts in the coastal areas of Venezuela, highlighting the IPCC's concepts, Climate Change Vulnerability and Risks and Reasons for Concerns. Their findings express a need for more standardization of the types of evaluations and procedures and the need for adjustments in selected methods to be applied in data-poor areas. In addition, they suggested adopting landscape ecological approaches in South America's coastal climate-related environmental impact assessments to help communicate management issues.

The most common keywords of the articles mentioned above are climate change/risk, adaptation, and hazard/threat/compound, which align with the proposed topic. Besides, they focus on vulnerability assessment, community risk management, sea level rise, flooding, extreme sea level, adaptation options, complex ecological modeling, coastal landscape ecology, precautionary strategies, uncertainty, stakeholders' participation, and coral reefs sub-areas of research, several of which have been among the most common terms in the last 10 years in coastal risk, vulnerability, impacts, and adaptation literature (Khojasteh et al., 2022).

Conclusion

Despite the heterogeneous contributions to this Research Topic and the limited number of articles, a few joint concepts emerge. Articles mainly focused on the assessment, management or communication of extreme compound events or multiple pressures and how local circumstances have a bearing on community stakeholders' engagement in planning and intervention of adaptation strategies and risk reduction, aside from government policies. Notably, the high coastal exposure to storm surges and flooding, which can potentially exceed biophysical and socio-ecological thresholds, explains the priority given to current extreme events in this Research Topic and literature.

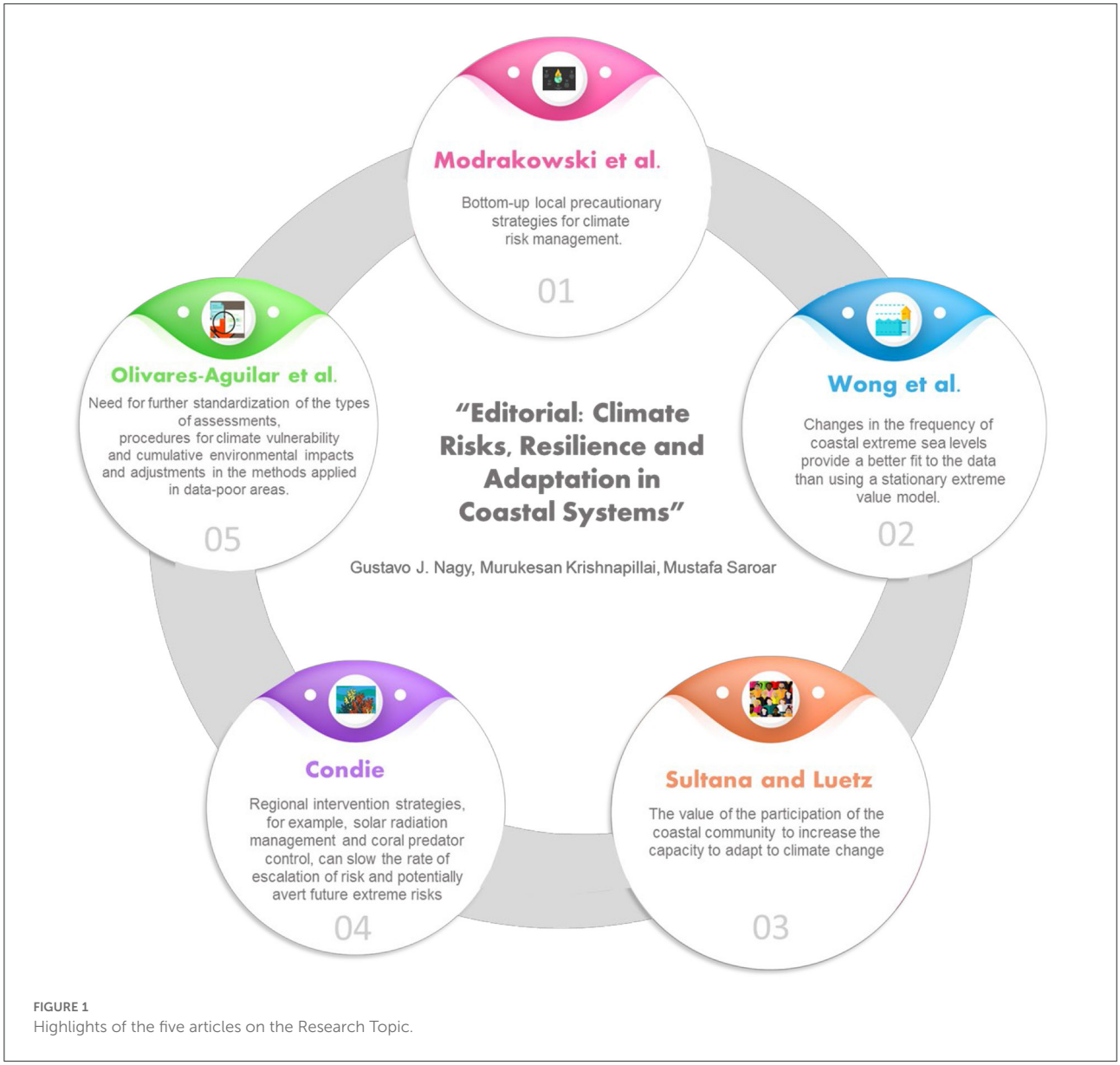

FIGURE 1
Highlights of the five articles on the Research Topic.

The outcomes of non-stationary changes in the frequency of coastal extreme sea levels to study storm surges (Wong et al.) will be a critical reason for concern and research due to the likely future increase of compound events and sea level (see Modrakowski et al.; Olivares-Aguilar et al.). Different methodologies like observational-based risk and vulnerability assessment (e.g., Condie; Olivares-Aguilar et al.; Wong et al.), and locally-based circumstances and engagement (e.g., Modrakowski et al.; Sultana and Luetz), show the need for flexible, integrated and open-minded management approaches to anticipate/respond to coastal climate risks.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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