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Editorial: Coasts Under Changing Climate: Observations and Modeling

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Editorial on the Research Topic

Coasts Under Changing Climate: Observations and Modeling

As sea-level rises due to climate change, providing salient information to support coastal risk management and adaptation is becoming a critical issue for numerous coastal communities and economic activities. The way this information is produced is now evolving rapidly as new observation and modeling capabilities are becoming available. This includes numerous multi-scale, multi-platform, terrestrial, airborne, and spatial remote sensing data, which can be combined with numerical modeling tools to improve our capabilities to reproduce past coastal evolutions and disasters, as well as to anticipate the future (e.g., Copernicus satellite and climate services). This Research Topic presents new research supporting coastal engineering and risk management, land use planning, integrated coastal zone management and coastal adaptation. It includes studies using and combining observations (e.g., *in-situ*, aerial, remote sensing) and models to understand and anticipate future coastal risks. Observation and modeling are key to facilitate the design and implementing prevention solutions that mitigate coastal risks. Among the articles published in this Research Topic, most deal with deterministic or probabilistic modeling with observations used for model validation and initialization. Six articles address coastal flooding, three address coastal erosion and one article focuses on ecosystem damage, while two articles concern coastal policy and management.

Flooding is often a result of the compound processes acting at multiple space scales, such as wind, waves, and surges, and their impacts on coastal zones is generally most accurate at local scales, where the flooding dynamics can be best represented. The contribution in this Research Topic, Höffken et al. investigates the influence of the duration and intensity of storm surge events on flood extent and water depths in coastal zones, and assesses the associated flood exposure for the case of the municipality of Eckernförde, Germany. Another local study by Orejarena-Rondón et al. presents an analysis on the coastal flooding impacts of the combined effect of extreme waves and sea level extremes in Bocagrande, Cartagena (Colombia). Both studies also evaluate the impacts of projected mean sea-level rise, further demonstrating the. Trošelj et al. quantify the impact of two extreme storm surge events in October 2006 on the Ibaraki Coast (Japan) in terms of sea surface elevation, water velocities and hydrographic imprints, using a fine (2 km) resolution dynamical downscaling.

Other studies in this Research Topic build upon the recent progresses obtained in broad scale or global flood modeling by the coastal scientific community. Tadesse et al. explore the potential of data-driven models to simulate storm surges based on atmospheric fields and indices at global scale. They find that at ∼70% of tide gages, mean sea-level pressure is the most important predictor to model daily maximum surge. Instead of using a statistical approach, Muis et al. present a novel CMIP6 global dataset of extreme sea levels, the Coastal Dataset for the Evaluation of Climate Impact

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(CoDEC), generated with a hydrodynamic model, which can be used to accurately map the impact of climate change on coastal regions around the world.

Understanding the long-term (50–100 year) evolution of coasts perturbed by human activities in a changing climate is of great importance for coastal zone planners and managers. Roelvink et al. present a new free-form coastline model, ShorelineS, that is able to simulate long term, local scale shoreline change based on relatively simple principles of alongshore transport gradient driven changes as a result of coastline curvature, including under highly obliquely incident waves. The model can reproduce complex behavior such as a splitting and merging of coastlines, and longshore transport disturbance by hard structures. Also describing possible evolution of coastal systems, the contribution by Bamunawala et al. focuses on the development and piloting of an innovative reduced complexity model G-SMIC that can probabilistically simulate climate-change driven evolution of inlet-interrupted coasts at 50–100 year time scales, while taking into account the contributions from catchment-estuary-coastal systems in a holistic manner. G-SMIC also quantifies the input-driven uncertainties associated with the evolution of Catchment-Estuary-Coastal systems over the twenty-first century.

A global increase in coastal hypoxia has emerged over the past decades due largely to a considerable rise in anthropogenically-derived nutrient loading. Zhou et al. investigate the physical and biogeochemical processes that create high-biomass phytoplankton production and hypoxia off the Changjiang (Yangtze River) Estuary in the East China Sea. Extensive *in situ* datasets are linked with a coupled Regional Ocean Modeling Systems (ROMS) and the Carbon, Silicate, and Nitrogen Ecosystem (CoSiNE) model to investigate the temporal decoupling of phytoplankton production and hypoxia. Such studies ultimately support better forecasts and projections of coastal hypoxia.

Finally, some of these multiple vulnerabilities are integrated in the perspective of management and policies. Terorotua et al. emphasize their major role in the co-design of tailored coastal climate services based on a case study of French Polynesia. In their contribution, the authors assess climate change perceptions by public authorities and identify their needs with regard to climate-related science. To enable a better anticipation of future risks due to sea level rise, Dayan et al. provide global to regional High-End Scenarios exploring an unlikely, but not impossible, scenario of rapid melting of ice-sheets from now to 2,200, supported by expert elicitation. While Dayan et al. remind that high-end scenarios can be relevant for risk-averse stakeholders concerned with e.g., critical infrastructure, the paper by Terorotua et al. delivers empirical evidence that the governance able to address the challenge still needs to be built up in many regions. Building this adaptation governance and capacity is part of today's coastal adaptation challenge that comes in addition to mitigating climate change and curbing marine and coastal biodiversity losses.

The coastal system can be regarded as co-evolving socio-economic and ecological systems experiencing substantial environmental pressures owing to the mechanisms of change exerted by human activities against a background of natural and climatic changes (Dada et al., 2021). Planning for the future use of the goods and services available from coastal ecosystems will therefore continue to be influenced or disturbed by unpredictable events. One way to account for the large volume of model projections and observations is their integration into increasingly complex holistic approaches and dissemination to the widest possible audience through simplified indices (Koroglu et al., 2019) available to coastal communities, which will maximize their use in sustainable coastal development and management. Papers in this Research Topic adds evidence for this sustainability challenge being increasingly considered in coastal science and operational coastal zones management.

AUTHOR CONTRIBUTIONS

RA, MM, GL, and RR contributed to the ideas development and writing. All authors contributed to the article and approved the submitted version.

REFERENCES

Dada, O., Almar, R., Morand, P., and Ménard, F. (2021). Towards West African coastal social-ecosystems sustainability: interdisciplinary approaches. *Ocean Coastal Manage.* 211:105746. doi: 10.1016/j.ocecoaman.2021.105746

Koroglu, A., Ranasinghe, R., Jiménez, J. A., and Dastgheib, A. (2019). Comparison of coastal vulnerability index applications for Barcelona Province. *Ocean Coastal Manage.* 178:104799. doi: 10.1016/j.ocecoaman.2019.05.001

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