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Editorial: Aquatic coastal ecosystems of monsoon Asia (ACEMON): their biogeochemical response to natural and anthropogenic perturbations

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Editorial on the Research Topic
Aquatic coastal ecosystems of monsoon Asia (ACEMON): their biogeochemical response to natural and anthropogenic perturbations

Monsoon Asia is a densely populated region hosting a diverse set of aquatic ecosystems comprising of lakes, rivers, estuaries, and coastal seas that are rich in biodiversity. To a great extent, their geophysical and biogeochemical features are defined by the prevailing seasonal weather patterns associated with the monsoons. Millions of people depend on these ecosystems for their basic needs, for example, water, food, employment and transport. Today, they are under threat from multiple hazards. Human activities in major river basins and rapid coastal and marine development are changing the fluxes and cycling of water, sediment, nutrients and pollutants, which, in turn, affect environmental habitability and ecosystem structure. Their impact is exacerbated by climate change (e.g., changing monsoon strengths, sea level rise, inundation and flooding, salination and extreme events).

Understanding the response of ecosystems that support and sustain the lives of millions of people to the hazards mentioned above are also of great interest in the context of UN Sustainable Development Goals (SDGs) and of measures needed to implement them. The papers included in the Research Topic give some relevant examples: taking advantage of the full potential of Indonesian coastal ecosystems for protection from natural hazards, distribution of emerging pollutants in aquatic ecosystems of the Philippines, and the response of marine ecosystems to South and East Asian monsoons in the Maldives and in the South China Sea and related material fluxes to the ocean's interior.

In their review Risandi et al. refer to knowledge gaps in the study of Indonesian seagrass ecosystems, which has mostly focused on ecological aspects of seagrass species. They discuss the role of seagrass in dissipating offshore wave energy and stabilizing nearshore

sedimentation. Unlike several comprehensive research efforts in Indonesia on mangroves, coral reefs and sandy beaches, there has been little incentive for research on the geophysical aspects of Indonesian seagrass ecosystems because of inadequate stakeholder awareness of these aspects. The authors make the case for more targeted studies to better understand the nearshore dynamics across tropical sea grass ecosystems because of their extremely diverse topographic settings and the experienced monsoon-related high wave energy. They underline the importance of such studies in the formulation of conservation measures similar to those being implemented in other, mostly temperate, regions of the world, and in taking full advantage of their potential as a natural protection against hazards from the sea.

Mariano et al. reports on aquatic pollution from pharmaceuticals and personal care products (PPCP) at three different sites in the Philippines. The sites included: a coastal tourist site, land use watersheds with agricultural activities and poultry farms, and a pristine atoll. They analyzed samples collected from hospital waste water, groundwater, rivers and coastal seawater during dry and wet seasons. Higher pollutant concentrations were observed during the dry season, which they interpret as a consequence of the presence of tourism-related transient population. They do not, however, discount dilution as a possible factor in the observed lower concentrations during the wet season. Overall distribution of individual pollutants reflect the proximity to communities, land use, and on the degree to which effective waste water treatment is in place. They conclude that further studies of this kind are needed and will be beneficial for implementing effective programs to manage pollution.

Foraminifera are a component of the biological carbon pump (carbonate pump) in the ocean. They respond to and incorporate the signals from prevailing environmental and hydrographic settings, and their sinking shells transfer these signals to sediments. This makes foraminifera preserved in sediments powerful geochemical proxies in palaeoceanographic reconstructions.

Lin et al. and Cariño et al. focus on the relationship between surface hydrographic settings driven by the monsoon and foraminifera fluxes to the ocean's interior in the South China Sea and the Maldives based on data collected using moored time-series sediment traps, which allow the collection of settling particles at preprogrammed intervals of time over longer periods. Higher foraminifera fluxes driven by monsoonal upwelling are known from earlier similar studies from the Asia region.

Lin et al. reports on the seasonal and interannual variability of foraminifera fluxes to the deep South China sea which were in phase with productivity in the surface waters. The controlling factor is a change in the nutrient inventory of surface waters driven by changing wind speeds associated with the East Asian monsoon. During the period of their research, they also observed the impact of El Nino warm and cold phases on foraminifera fluxes. Higher shell fluxes occurred during cold phases and higher windspeeds. A change in windspeeds by 15%–17% caused a several fold change in fluxes. Low fluxes during warm ENSO phases are shown to be due to the intrusion of low nutrient Western Pacific Surface waters to their study area.

In the Maldives, Cariño et al. observed high foraminifera fluxes during the monsoons. Unlike in regions to the north of the study area where higher foraminifera fluxes were related to monsoonal upwelling, they link higher fluxes to increased surface productivity driven by strong winds and deeper mixing, and the resulting nutrient injection to the surface layers. The observed dominance of shallow dwelling species at their sites support this conclusion. They also observed wind-driven extension of chlorophyll rich surface waters to the east and west of their research sites during SW and NE monsoon, respectively, and this could also have contributed to higher foraminifera fluxes. It would appear that the recorded fluxes integrate the impact of monsoons on the overall region around their sites. The results are particularly relevant for palaeoceanographic studies using sediment cores from the study area, which is considered to preserve a 25 million year long palaeoceanographic record.

Because of the role played by foraminifera in the workings of the biological carbon pump, the results from these two papers give a glimpse of how the biological carbon pump might operate under changing monsoon strengths and changing frequency of ENSO events—both are projected effects of climate change.

Author contributions

VI: Conceptualization, Writing–original draft, Writing–review and editing. YW: Conceptualization, Writing–review and editing. XS: Conceptualization, Writing–review and editing. VS: Conceptualization, Writing–original draft, Writing–review and editing. BG: Conceptualization, Writing–review and editing.

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.

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