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Editorial: Physical oceanography processes at eastern boundary upwelling systems

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Editorial on the Research Topic
Physical oceanography processes at eastern boundary upwelling systems

With immense pleasure and pride, we present this special Frontiers in Marine Science Research Topic titled "*Physical Oceanography Processes at Upwelling Systems*." This Research Topic comprises ten exceptional research papers sourced from diverse oceanic realms across the globe.

The Upwelling Systems are captivating domains characterized by complex oceanographic processes that profoundly influence marine ecosystems, climate dynamics, and regional weather patterns. Exploring the intricate mechanisms in these unique systems is crucial for deciphering the fundamental drivers of oceanic behavior and their global implications. The research presented within this Research Topic unravels critical insights into these processes, enhancing our comprehension of the vast and intricate world beneath the surface waves. Spanning ten diverse articles, we traverse various locations, from the East Australian Current region to the Baltic Sea's Gulf of Riga, through the North Humboldt Upwelling System, the Sea of Japan, the eastern Atlantic Ocean and the Southwest East Sea.

Liu et al. delved into the seasonal variability of the East Australian Current (EAC), a significant component of the South Pacific subtropical circulation, revealing notable fluctuations in mesoscale eddy kinetic energy (EKE). Their study, which analyzed satellite altimeter data and employed an eddy-resolving ocean model, identified peak EKE in the upper ocean along Australia's east coast during summer and a minimum in winter. The research emphasized the influence of mixed instabilities, governed by both barotropic and baroclinic processes, and shed light on the dynamic mechanisms shaping EKE in the EAC region.

Alves et al. explored the intra-seasonal variability of the Canary upwelling system, focusing on the impact of low-level jets, including the continental coastal jet, Madeira's tip jets, and the Canary Islands' tip jets. Through a high-resolution fully coupled ocean-atmosphere numerical simulation, the study unraveled the intricate interactions among these jets, driven by oscillations in the Azores subtropical anticyclone. The

research highlighted the role of coastal-trapped oscillations, offering insights into potential climate change implications for the region.

Yari et al. analyzed the role of surface wind in the Peruvian upwelling system, conducting a detailed examination spanning seven decades. Their research identified significant fluctuations in the surface wind field over various timescales, with a focus on interannual semi-periodic wind fluctuation linked to El Niño Southern Oscillation (ENSO) and a decadal semi-regular fluctuation attributed to the Interdecadal Pacific Oscillation. The study revealed asymmetric wind anomaly patterns during ENSO phases and their implications for sea surface temperature and wind stress co-variability in the Humboldt Upwelling System.

Estrada-Allís et al. investigated turbulent mixing within the Cape Ghir upwelling filament in the African Eastern Boundary Upwelling System. Unlike previous assessments, their study detected enhanced turbulent kinetic energy dissipation rates linked to increased vertical current shear at the mixed layer's base. Through a one-dimensional turbulent entrainment approach, the research highlighted the impact of vertical shear and the active mixing layer depth on filament characteristics, emphasizing the importance of vertical shear often overlooked in existing parameterizations.

García-Reyes et al. utilized high-resolution sea surface temperature data to examine the spatial dynamics of Eastern Boundary Upwelling Systems (EBUS) and their coastal footprints. Their study suggested that the Humboldt and Iberian/Canary EBUS exhibit no contraction in their footprints on annual or seasonal scales, with implications for marine life and regional refugia. The research underscored the potential consequences for marine life and highlighted variations across regions and seasons.

Kim et al. investigated the quantitative contributions of wind stress and ocean currents to coastal upwelling along the southwest coast of the East Sea (Japan Sea), shedding light on the mechanisms influencing coastal upwelling and its impact on ocean ecosystems.

Rivas et al. explored the impact of the ENSO on the Northeastern Pacific Ocean, particularly the Baja California Peninsula. Using a mesoscale-resolving numerical ocean model, the study highlighted the role of air temperature and wind stress anomalies in driving regional warm anomalies with potential implications for biogeochemistry.

Fearon et al. delved into the influence of super-diurnal winds associated with the land-sea breeze (LSB) on the southern Benguela upwelling system. The LSB's crucial role in productivity and Harmful Algal Bloom development in St Helena Bay was emphasized, providing insights into the physical and biological functioning of the system.

Topé et al. utilized two high-resolution simulations of the NEMO model to elucidate the warming influence of the Niger River on the eastern part of the northern Gulf of Guinea upwelling. Their study revealed the Niger River's role in inhibiting cold-water upwelling through reinforcing stratification and preventing vertical shear of horizontal currents.

Skudra et al. investigated upwelling events in the Gulf of Riga from 2010 to 2022, revealing distinct phases and varied characteristics influenced by coastline orientation. The study suggested that weaker gradients could explain fast upwelling relaxation in the basin compared to larger Baltic Sea gulfs.

We want to express our heartfelt gratitude to the authors who entrusted us with their valuable contributions to this Research Topic. Your dedication and commitment to advancing marine science have enriched this compilation, adding depth and breadth to our understanding of the upwelling systems. Furthermore, we appreciate the diligent reviewers who invested their time and expertise in meticulously evaluating and refining the submissions. Your constructive feedback has been instrumental in maintaining the published works' highest quality and academic rigor. Additionally, our gratitude goes to the esteemed researchers who served as guest editors, guiding, and shaping the research articles and ensuring comprehensive and extensive coverage of this Research Topic.

This diverse set of studies not only enhances our understanding of the complex physical processes in coastal upwelling systems but also underscores their geographic significance and role in our oceans' global connectivity.

As we embark on this oceanographic journey, delving into the intricacies of Upwelling Systems, we invite you to immerse yourselves in the following pages. May this Research Topic inspire further exploration, collaboration, and innovation in the ever-evolving field of marine science.

Author contributions

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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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