# Special Issue on Aquatic Science and Technology (i-CoAST) Part 3

## Preface

The trajectory of this special issue has moved steadily from observation toward action. The first part marked the tenth anniversary of the International Conference on Aquatic Science & Technology (i-CoAST) and surveyed the breadth of the field, while the second turned toward the interpretive layer of aquatic science—the confidence with which sensor-derived information can be trusted and the interoperability that allows heterogeneous datasets to be exchanged across domains. This third installment carries that logic to its operational conclusion. It gathers work in which sensing systems, numerical models, and engineered materials are brought into the field to quantify coastal change, anticipate hazards, and safeguard the environments and critical facilities that depend on the sea.

This part comprises twelve peer-reviewed contributions that together trace a path from the seabed and shoreline to the instruments and standards through which they are observed, the models by which their hazards are assessed, and the materials and structures by which coasts are protected. Their scope spans acoustic and optical remote sensing of morphological and sediment change, geospatial data standardization and digital-twin integration, the numerical modeling of tsunamis and storm surges, marine radioactivity monitoring from sample preparation to in situ detection, and sustainable coastal engineering.

The observation of morphological and sediment change forms the first thread. Yeon and Lim analyzed how beach area responds to a gradual decrease in sediment supply, deriving background erosion from sediment mass conservation and validating the approach against aerial maps of Korean beaches spanning the 1970s to the 2010s, with direct implications for beach nourishment planning. J. H. Kim *et al.* used two-epoch bathymetric datasets acquired by a unmanned surface vessel (USV)-mounted multibeam echosounder to quantify seabed settlement and scour around an offshore wind-turbine monopile and to estimate the placed backfill volume within an uncertainty-aware framework that separates genuine bed-level change from measurement noise. H.-S. Kim *et al.* integrated unmanned-aerial-vehicle RGB imagery with in situ turbidity measurements to map suspended sediment concentration at high spatiotemporal resolution, tracking sediment plumes at scales that neither fixed sensors nor satellites can capture alone.

Standardization and digital integration constitute the second thread. M. S. Kim *et al.* also addressed the interoperability challenges emerging among S-100-based product specifications—Electronic Navigational Charts (S-101) and Bathymetric Surface (S-102)—ahead of the transition to S-100-based Electronic Chart Display and Information System (ECDIS), proposing a data-governance framework that spans the entire data lifecycle to secure the semantic consistency required for S-98 interoperability. Lee *et al.* developed an integrated geospatial digital-twin simulation system for the S-shaped tidal channel of the Suncheon Bay wetland, fusing sonar bathymetry, aerial photogrammetry, and in situ hydrographic sensors with hydrodynamic and salinity modeling, and validating the reconstruction across dry and wet seasons.

The third thread turns to the numerical assessment of coastal hazards. H.-J. Kim *et al.* further developed a smoothed-particle-hydrodynamics model incorporating fluid–rigid-body interaction to predict the initial wave amplitude of submarine-landslide-generated tsunamis, deriving a new nondimensional equation suited to early tsunami risk assessment and warning. Hwang *et al.* examined tide–surge interaction at a nuclear power plant site on Korea's macrotidal west coast using the ADvanced CIRCulation (ADCIRC) model and thirty-three synthetic typhoon scenarios, showing that the simple linear superposition of tide and surge can overestimate extreme water levels and identifying the typhoon parameters that most strongly govern surge severity.

Marine radioactivity monitoring forms the fourth and most prominent thread of this issue. M. J. Kim *et al.* developed an automated radiochemical preconcentration and purification system, coordinated by a LabVIEW-based digital-twin platform, for the rapid pretreatment of radiostrontium from large-volume seawater samples as a front end to downstream radiation sensing. Min *et al.* built a closed-loop system in which Prussian-blue–alginate beads adsorb radiocesium while NaI(Tl) and $LaBr_3$ detectors enable continuous in situ gamma spectrometry, achieving simultaneous Cs-137 removal and real-time quantification. Ji *et al.* developed the MARK-Underwater series of in situ underwater gamma-ray detection systems, each optimized for a distinct monitoring task and verified through Monte Carlo simulation and field experiments, extending marine radiological surveillance in both temporal continuity and operational reach.

The final thread concerns the engineering of resilient coasts through sustainable materials and protective structures. Ko *et al.* evaluated a biopolymer-based levee reinforcement material in a steep-slope flume, using high-speed-camera-based noncontact sensing to determine permissible flow velocity and shear stress, and demonstrated durability well beyond conventional revetment requirements. Yoon *et al.* proposed a semicylindrical rotating-buoy wave-energy converter installed at the front of a floating breakwater and, through video-based motion analysis,

characterized its heave and pitch response, revealing a transition in the dominant motion mode with wave period and pointing toward designs that couple coastal protection with wave-energy harvesting.

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