Data, Observation & Modelling

Thu. Nov 12, 2026 2:00 PM - 3:30 PM JST | Thu. Nov 12, 2026 5:00 AM - 6:30 AM UTC | Room A (Oshidori) (2F)

Oral A2 Coastal Resilience & Hazard Mitigation

Chair: Joaquin Tintore, Urmas Lips

3:15 PM - 3:30 PM JST | 6:15 AM - 6:30 AM UTC

[swOhB7iC-06] An Integrated Digital Twin Framework for Hydro-Meteorological and Coastal Risk in the Bay of Bengal

Mohan Kumar Das (Hydro-Climate and Ocean Centre (HCO))

The Bay of Bengal is a dynamic ocean,Äìatmosphere,Äìland system where extreme precipitation, monsoonal disturbances, river flooding, storm surges, and sea-level variability interact to generate compound hazards and cascading impacts across coastal Bangladesh. Fragmented observation and prediction systems constrain the representation of these interactions and the delivery of timely, impact-relevant information. This study develops an interoperable digital-twin architecture that combines satellite and in-situ observations, gridded meteorological products, numerical weather and climate simulations, hydrological information, and machine learning models. The methodology integrates data harmonization, data,Äìmodel coupling, event-based analysis, predictive modelling, and predictive analytics to connect environmental states with hazard evolution across the ocean,Äìatmosphere,Äìland continuum. Across 20 hydro-meteorological and coastal events during 2010,Äì2026, the system achieved a rainfall correlation coefficient of 0.67, an RMSE of 22 mm, and an event-detection rate of 77%, with a 60% improvement in overall predictive performance relative to the baseline system. It extended the useful forecast lead time to 8 hours and improved identification of compound events. The system linked environmental evolution with exposure and impacts, providing a science-to-society pathway from prediction to early warning and actionable decision support for communities, infrastructure, ecosystems, and coastal management. These results demonstrate the feasibility of connecting heterogeneous observations, predictive models, and impact information within a common digital environment, providing a practical route from fragmented systems toward functional digital-twin services for hazard forecasting, disaster preparedness, climate resilience, and sustainable coastal management in the Bay of Bengal.

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