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

2:30 PM - 2:45 PM JST | 5:30 AM - 5:45 AM UTC

[swOhB7iC-03] DTO of compound coastal-fluvial floods

*Indiana Olbert (1. University of Galway (Ireland))

Floods are the most pervasive and costly weather-related natural disasters, and future climate may increase the flood risks and impacts. In estuaries the compound nature of coastal–fluvial flooding and the intricacies of built environments present challenges for flood understanding. Flood prediction requires integrated and multi-hazard multi-model and multi-observational approaches. This research aims to develop a Digital Twin for Ocean of coastal–fluvial floods using advanced physics-based and data-driven models.
The proposed DTO for compound flood modelling is a novel framework that integrates advanced data- and physics-based models with both in-situ and satellite observations. The ultra-high resolution hydrodynamic model is used to simulate a wide range of hydrological and coastal scenarios, as well as their combinations. Time series of water depths at each numerical grid point (6x6m) of an urban riverine–estuarine domain capture the evolution of flood events over the city-wide floodplains. Sentinel-1 SAR satellite products are used to validate historical flood events. The AI-driven component employs a range of machine learning and deep learning algorithms trained on outputs from hydrodynamic simulations of non-flood to extreme-flood conditions. Ultimately, the best-performing AI model is selected for each grid point individually and used to simulate water levels across the urban floodplains.
The AI-based component of DTO produces short-term flood predictions by integrating a variety of features, including meteorological and sea level conditions. The system’s performance is demonstrated for the coastal city of Cork, the second-largest city in Ireland that is frequently affected by coastal flooding. Results show that the hydrodynamic model can reproduce historical flood events with a very high accuracy while several AI models are able to simulate coastal urban flooding when trained on hydrodynamic model outputs. Reliable what-if scenario modelling of compound floods offers numerous societal benefits, including improved flood preparedness, greater confidence in decision-making and climate adaptation.

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