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Towards a Coastal Digital Twin for the Kiel Region: Modelling Flooding Scenarios for Operational Flood-Risk Management

Extreme water levels along the German Baltic coast, primarily driven by storm surges, are posing increasing risks due to climate-induced sea level rise. To support flood-risk manage-ment in coastal areas and enhance climate resilience, we present a prototype model, which is intended to be integrated on a Digital Twin of the Coast for the Kiel region, from Damp to Hohwacht. Based on a calibrated and validated regional hydro-dynamic model, we simulate a 200-year storm surge under three sea level rise (SLR) scenarios: low (0.58 m), medium (0.78 m), and high (0.87 m).

The model integrates high-resolution topographic data, dynamic flood modelling, and land use exposure analysis to generate interactive coastal flood maps. These maps enable stakehold-ers to assess flood characteristics such as extent, depth, and impact on land use. Results indicate that flood extent increases from 16.2 ha under current conditions to 25.3 ha (0.58 m SLR), 28.1 ha (0.78 m), and 29.2 ha (0.87 m). The diminishing differences between the medi-um and high scenarios suggest that significant impacts may occur well before 1 m of SLR.

This coastal digital twin will provide a science-based, user-oriented planning tool that enables scenario testing, real-time simulations, and risk-informed decision-making. It can serve as a foundation for adaptive coastal protection strategies, illustrating the potential of digital twins to bridge scientific modelling and practical management in the face of accelerating climate change.

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