HIDRA3: A Robust Deep-Learning Model for Multi-Point Sea-Surface Height and Storm Surges Forecasting

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Accurate forecasting of storm surges and extreme sea levels is crucial for mitigating coastal flooding and safeguarding communities. While recent advancements have seen machine learning models surpass state-of-the-art physics-based numerical models in sea surface height (SSH) prediction, challenges persist, particularly in areas with limited SSH measurement history and instances of sensor failures. In this study, we developed HIDRA3, a novel deep-learning approach designed to address these challenges by jointly predicting SSH at multiple locations, allowing the training even in the presence of data scarcity and enabling predictions at locations with sensor failures. Compared to the state-of-the-art model HIDRA2 and the numerical model NEMO, HIDRA3 demonstrates notable improvements, achieving, on average, 5.0% lower Mean Absolute Error (MAE) and 11.3% lower MAE on extreme sea surface heights.