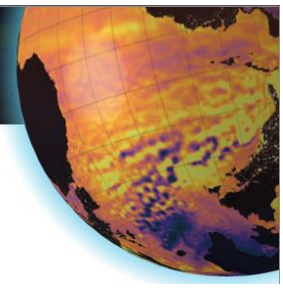
Enhancing Coastal Resilience in Taiwan through Satellite-Based Multi-Hazard Prediction Systems and Blue Carbon Integration

Taiwan, situated at the intersection of the Kuroshio Current and the China Coastal Current, faces significant challenges due to its tropical and subtropical climate, frequent typhoons, and complex coastal dynamics. This study presents the development and evaluation of a satellite-based multi-hazard coastal prediction system designed to enhance resilience in Taiwan's coastal regions. The system leverages high-resolution satellite data from missions such as Sentinel-3B to provide accurate and timely predictions of multiple hazards, including sea level rise, coastal erosion, and storm surges. Utilizing data from these satellite missions, the system integrates real-time observations of sea surface heights, three-dimensional currents, temperature, salinity, and wave-induced mixing. Case studies from various coastal regions in Taiwan, such as Chiayi and northern Taiwan, demonstrate the system's capability to support decision-making in emergency response, urban planning, and sustainable development. The results highlight the importance of integrating diverse satellite data sources to address the complex challenges faced by Taiwan's coastal communities. The study also explores the role of blue carbon ecosystems, such as mangroves and seagrass beds, in mitigating the impacts of climate change. These ecosystems are critical for carbon sequestration and provide natural barriers against coastal erosion and storm surges. Taiwan has set an ambitious target to expand its blue carbon reserves to 700,000 tons by 2030, recognizing the significant carbon offsetting potential of these ecosystems. The integration of blue carbon data into the prediction system enhances its ability to forecast and manage coastal hazards effectively. Furthermore, the research incorporates a climate change risk index to assess the vulnerability of different coastal regions in Taiwan. This index considers factors such as sea level rise, frequency of extreme weather events, and the resilience of local ecosystems. This research underscores the critical role of satellite technology and blue carbon ecosystems in advancing coastal prediction science and fostering resilience against long-term environmental challenges. By leveraging the latest advancements in satellite data integration and blue carbon initiatives, this study aims to provide a robust framework for mitigating the impacts of natural disasters and promoting sustainable coastal development in Taiwan.

Laili Fitria, Department of Civil Engineering, Chung Yuan Christian University, Taoyuan 32023, Taiwan; Sheng-Jie You, Department of Environmental Engineering,



Chung Yuan Christian University, Taoyuan 32023, Taiwan; Ya-Fen Wang, Department of Environmental Engineering, Chung Yuan Christian University, Taoyuan 32023, Taiwan