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Editorial

Storm Tide and Wave Simulations and Assessment

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1. Introduction

Storm tides, surges, and waves associated with typhoons/tropical cyclones/hurricanes are among the most severe threats to coastal zones, nearshore waters, and navigational safety. Therefore, predicting typhoon/tropical cyclone/hurricane-induced storm tides, surges, waves, and coastal erosion is important to reduce loss of human life and property and to mitigate coastal disasters. Although many studies on hindcasting/predicting/forecasting of typhoon-driven storm tides, surges, and waves as well as the morphological evolution have been carried out through numerical models in the last decade, there is still a growing demand for novel techniques which could be adopted to resolve the complex physical processes of storm tides, surges, waves, and coastal erosion.

To improve and enhance our simulating and analytic capabilities and understanding of storm tides, surges, and waves, this Special Issue is intended to collect the latest studies or reviews on storm tides, surges, and waves modeling and analysis utilizing dynamic and statistical models and artificial intelligence approaches. Seven high-quality papers have been published in this Special Issue which cover the application and development of many high-end techniques for storm tides, surges, and waves: for instance, employment of an artificial neural network for predicting coastal freak waves [1]; reproduction of super typhoon-created extreme waves [2]; numerical analysis of nonlinear interactions for storm waves, tides, and currents [3]; wave simulation for an island using a circulation-wave coupled model [4]; analysis of typhoon-induced waves along typhoon tracks in the western North Pacific Ocean [5]; understanding of how a storm surge prevents or severely restricts aeolian supply [6]; and investigation of coastal settlements and assessment of their vulnerability [7].

2. Details of the Papers

Doong et al. [1] propose a probabilistic coastal freak wave (CFW) forecasting model that is an advancement of a previously proposed deterministic CFW forecasting model. They also develop a probabilistic forecasting scheme to make an artificial neural network (ANN) model achieve probabilistic CFW forecasting.

Hsiao et al. [2] employ the Climate Forecast System Version 2 (CFSV2) winds under varying spatial and temporal resolutions to simulate large waves driven by a duper typhoon. They indicate that the simulated storm wave heights tend to decrease significantly due to the lower spatial resolution of hourly winds from the CFSV2 dataset; however, the variations in the storm wave height simulations were less sensitive to the temporal resolution of the wind field.

Hsiao et al. [3] use a high-resolution, unstructured-grid, coupled circulation-wave model (Semi-implicit Cross-scale Hydroscience Integrated System Model Wind Wave Model version III (SCHISM-WWM-III)) to investigate the sensitivity of storm wave simulations to storm tides and tidal currents. They find that the simulated significant wave height, mean wave period, and wave direction for a wave buoy in the outer region of a typhoon are more sensitive to tidal current but less sensitive to tidal elevation than those for a wave buoy moored in the inner region of a typhoon and also suggest that the inclusion of tidal current and elevation could be more important for typhoon wave modeling in sea areas with larger tidal ranges and higher tidal currents.

Yang et al. [4] apply a numerical wave model Simulating Waves Nearshore (SWAN), which resolves nearshore wave processes, and a hydrodynamic model, the Finite-Volume Community Ocean Model (FVCOM) to simulate waves and currents during Typhoon Fung-wong (2014) and Typhoon Chan-hom (2015) around the Zhoushan Islands. The influence of sea-surface currents, e.g., typhoon-induced and tidal currents, as well as the sea-water level, on wave simulation was also studied.

Hu et al. [5] use version 5.16 of the WAVEWATCH-III (WW3) model to simulate parameters of typhoon-generated wave fields in the western North Pacific Ocean during the period 1998–2017. Overall, a typhoon-induced wave energy dominates north of 30° N. Temporal analysis of the leading principal component of significant wave height indicates that (a) the intensity of the wave pattern produced by westward-tracking typhoons decreased during the last 20 years and (b) typhoons that recurve east of 140° E and those that track westward toward southeast Asia are largely responsible for the decadal variability of typhoon-induced wave distribution.

Tuijnman et al. [6] predict aeolian supply during a 2-day surge period to be about 66% of the potential supply using a fetch-based model. Fetch limitations imposed by the surge-induced inundation and the continuous saturation of sand on the emerging beach both contributed to the predicted supply limitation. Their results quantitatively support earlier studies that suggested surges to be the primary condition that causes predictions of long-term potential foredune growth to overestimate measured growth.

Lin et al. [7] use the east coast of Taiwan as an example, through geographic information system (GIS) and statistical analysis in land-use status, vulnerable population groups and Unmanned Aerial Vehicle (UAV) landscape signs of indicators of erosion and accumulation. Through the main output of an intuition scatter map, the erosion landscape susceptibility, economical land-use exposure, and special population groups' ratio allowed for easy comparison of the vulnerability, risk level, and resilience between different coastal settlements.

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