TYPHOON-INDUCED EFFECTS ON WAVE EVOLUTION ACORSS COASTAL WETLANDS

Ying Zhao, East China Normal University, 52213904019@stu.ecnu.edu.cn
Zhong Peng, East China Normal University, zpeng@sklec.ecnu.edu.cn

INTRODUCTION

Coastal wetlands play a pivotal role in providing a natural shield against the relentless forces of wave energy and storm surges. Previous research, as demonstrated by Zhao et al. (2023), underscores the substantial impact that mudflats and saltmarsh areas can exert on the intricate process of wave evolution. Their ability to absorb, deflect, and dissipate wave energy makes coastal wetlands a vital component of the coastal landscape. Understanding the intricate dynamics of how waves transform and evolve as they interact with these ecosystems holds great significance. Such knowledge empowers us to comprehensively assess the effectiveness of coastal wetlands in mitigating flood risks, curbing erosion, and facilitating the movement of sediments within coastal environments. Furthermore, we witness the emergence of large and potent waves induced by typhoons can dramatically impact coastal regions. These typhoon-induced waves have the potential to trigger significant changes in wave distribution, alter the profiles of significant wave height, and reshape wave spectrums (Collins et al. 2018) along the coast. However, our understanding of how typhoons precisely influence the evolution of waves across coastal wetlands remains incomplete. As such, this study investigates the typhoon-induced effects on wave evolution at coastal wetlands, deepening our comprehension of wave evolution within these ecosystems. This research will not only aid in bolstering our coastal defences but also contribute to the broader field of coastal science and resilience.

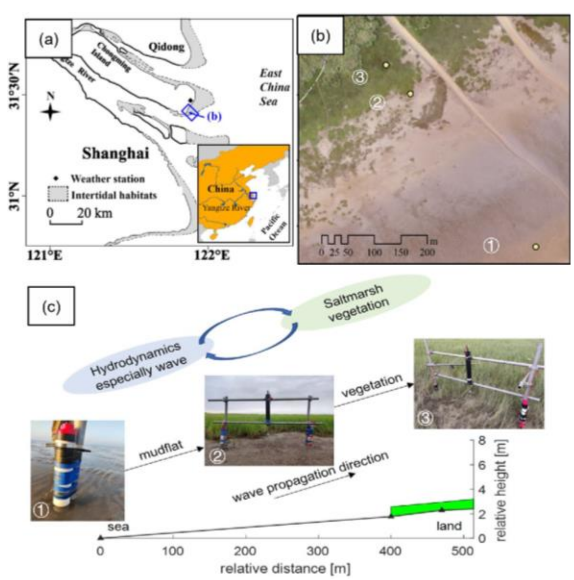

Figure 1 - (a) Study area (Xie et al. 2018), (b) observation stations (121°56'12.988''E, 31°27'20.69''N; 121°56'2.5''E, 31°27'32.15''N and 121°56'0.760''E, 31°27'33.95''N), (c) station information

METHODOLOGY

This research conducted the field campaign in Eastern Chongming Island, Shanghai, which serves as a representative estuarine wetland within the Yangtze River Estuary (as noted by Li et al. in 2014). Three observation points were established (Fig. 1b): one on the mudflat (referred to as point 1), one at the boundary between the mudflat and vegetation (referred to as point 2) and one within the vegetation (referred to as point 3). Data collection took place in 2022 (UTC+8) from 18:00 on September 8th to 18:00 on September 15th. It's worth noting that during the observation period, specifically from September 12th to September 15th, the measurement points were subjected to the effects of Severe Typhoon Muifa. The tidal cycle characterized by the highest storm intensity was chosen to represent typhoon conditions. Furthermore, through harmonic analysis, the tidal cycle symmetrically aligned with the typhoon-induced tidal cycle was selected as representative of normal conditions.

PRELIMINARY RESULTS

The difference in individual wave distribution, significant wave height attenuation and spectrum evolution between normal conditions and typhoon conditions are investigated. Preliminary results show that the distribution of individual wave heights is positively skewed with a thick and long tail across the mudflat. However, within the vegetation area, the distribution of wave height becomes more peaked, and the tail becomes shorter. New formulae, relating to root-mean-square wave height (Hrms) and peak wavelength (Lpeak), are proposed to fit wave distribution on the tidal flat. Findings show that typhoon events attenuate more wave energy than normal conditions because wave breaks occur during the typhoon but shoaling in normal conditions. It was found that the opposing current increases the overall wave attenuation by enhancing wave breaking. Finally, results show wave nonlinearity increases over coastal wetlands during typhoon events. The findings in this study would enable engineers to know wave evolution during typhoon events over coastal wetlands, promoting the development of ecosystem-based coastal engineering.

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