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In Chapter 1, a fully-coupled (hydrodynamic and morphologic) numerical model is presented, and utilized for the simulation of tsunami-induced scour around a monopile structure, representative of those commonly utilized as offshore wind turbine foundations at moderate depths i.e. for depths <O(30 m). The model is based on solutions to Reynolds-averaged Navier-Stokes equations, coupled with two-equation $k$-$\omega$ turbulence closure, with additional bed and suspended load descriptions forming the basis for sea bed morphology. The model is first validated for flow, bed shear stresses, and scour within a steady current, where a generally excellent match with experimentally-based results is found. A methodology for maintaining and assessing hydrodynamic and morphologic similarity between field and (laboratory) model-scale tsunami events is then presented, combining diameter-based Froude number similarity with that based on the dimensionless wave boundary layer thickness-to-monopile diameter ratio. This methodology is utilized directly in the selection of governing tsunami wave parameters (i.e. velocity magnitude and period) used for subsequent simulation within the numerical model. The flow, sediment transport, and scour processes beneath three tsunami waves are simulated in succession. These illustrate a generally accumulative scour process i.e. a relatively rapid scour induced by the leading wave, with an additional buildup of the scour depth during additional trailing waves. The resulting scour seems to approach an equilibrium value after sufficient time duration, which corresponds reasonably to that predicted by existing steady-current scour depth, after invoking a boundary layer thickness based on the unsteady tsunami wave, i.e. it is important to incorporate both current-like, as well as wave-like aspects of the long tsunami event. Based on the simulated results, a simple methodology for predicting the scour depth in engineering practice is finally developed. This methodology is demonstrated to match the predicted maximum scour for all of the simulated flows considered i.e. ranging from the series of transient tsunami waves to the steady-current limit. In Chapter 2, the aim is to provide an overview on the tsunami impacts on aquaculture rather than presenting a comprehensive review on the status and trends in aquaculture development. [For such a comprehensive review the reader is referred to the FAO (Food and Agriculture organization of the United Nations) report titled "The State of the World Fisheries and Aquaculture" released in May 2014.] For this purpose, we first briefly provide and introductory summary on aquaculture. This is followed by the section "Vulnerability of Fisheries and Aquaculture Systems" where the main focus is the vulnerability to tsunamis. Next, tsunami Impacts on aquaculture are exemplified based on the major tsunami events that occurred since 2000s. Later, specific case studies highlighting different aspects in aquaculture design are illustrated in the section "Engineering Design of Aquaculture Systems". In Chapter 3, tsunami impact on coastal ecosystems is investigated. Ecosystems along the coast of Portugal are considered and a detailed numerical modelling of tsunami impact is performed for the Ria Formosa lagoon (an important ecosystem located in the southern coast of Portugal). The tsunami modelling is carried out using a validated non-linear shallow water numerical code. A high resolution digital elevation model (50m-resolution) of the zone of interest is used to properly simulate the tsunami hazard. The active earthquake sources of the southwest Iberia Margin (SWIM) region represent the tsunamigenic scenarios in this study. Tsunami impact at the Ria Formosa lagoon is assessed through deriving near-shore tsunami wave heights, inundations, and flow velocities. Numerical results show that the Ria Formosa lagoon can suffer powerful tsunami impact due to the occurrence of a tsunami event in the SWIM region.

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