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Deterministic and Probabilistic Tsunami Hazard Assessment for Inner Basin of Izmir Bay by High Resolution Tsunami Inundation Modeling

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There are numerous strong earthquakes which occurred in Aegean Sea and recorded in history. The 12th of June, 2017 Lesvos event at North of Karaburun Peninsula at Western Coast of Turkey is one of the recent important examples. The region is tectonically active, and the seismicity is high as declared by the Disaster and Emergency Management Presidency of Turkey (AFAD). Since the region is highly prone to catastrophic events, such as earthquakes or earthquake/landslide-induced tsunamis because of the nearby active fault zones and their recent activities, the awareness about tsunamis that might take place around the western coasts of Turkey should be raised. Izmir is the third largest city of Turkey. According to the historical records, tsunami events have affected the nearby coastal settlements such as Izmir metropolitan city. Furthermore, according to the historical documents and distribution of the undersea fault zones and other probable tsunamigenic sea bottom deformations, there are numerous source areas which may be considered as responsible for the tsunamis in Aegean Sea. To predict and interpret tsunami wave propagation and inundation throughout a hazard assessment, numerical modeling is one of the important tools. High resolution numerical simulations provide information on inundation patterns and thus are useful in risk assessment, early warning and vulnerability analyses (Taubenbock et al., 2009). However, inundation processes are difficult to model due to complex interactions at the shore and on land (Dalrymple et al., 2006). In modelling studies of populated areas such as Izmir Bay, ignorance of buildings strongly influences the inundation and may cause a significant overestimation of the inundation extent. If every structure on the high resolution data is identified clearly, tsunami waves are supposed to show different propagation when they encounter with a structure. Hence different approaches to consider buildings were used and analysed by both deterministic and probabilistic procedures. This study highlights the effects of considering buildings and other land structures in inundation simulations used for local risk assessment. The availability of high-resolution data for this study area allowed us to conduct a case study to further analyse the required quality and influence of high-resolution data and buildings on inundation simulations. As deterministic approach, a series of numerical computations are performed by using tsunami simulation and visualization code NAMI DANCE which solves nonlinear form of shallow water equations with friction term in nested domains in GPU environment. Moreover, Probabilistic tsunami hazard assessment (PTHA) enhances identification of tsunami hazard probabilities which help to combine it with vulnerability and degree of hazards of tsunami risk. In this study, PTHA is applied to inner basin of Izmir Bay to provide estimation of earthquake magnitudes for the return periods of 100, 500 years which are used for tsunami hazard analysis, and to obtain reliable results for local risk assessment.

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