Development of an Operational Typhoon Swell Forecasting and Coastal Flooding Early Warning System

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Coastal floods and typhoon swells are a consistent threat to oceanfront countries, causing major human suffering and substantial economic losses, such as wrecks, ship capsized, and marine construction failure, etc. Climate change is exacerbating the problem. An early warning system is essential to mitigate the loss of life and property from coastal flooding and typhoon swells. The purpose of this study is to develop a typhoon swell forecasting and coastal flooding early warning system by integrating existing sea-state monitoring technology, numerical ocean forecasting models, historical database and experiences, as well as computer science. The proposed system has capability offering data for the past, information for the present, and for the future. The system was developed for Taiwanese coast due to its frequent threat by typhoons. An operational system without any manual work is the basic requirement of the system. Integration of various data source is the system kernel. Numerical ocean models play the important role within the system because they provide data for assessment of possible typhoon swell and flooding. The system includes regional wave model (SWAN) which nested with the large domain wave model (NWW III), is operationally set up for coastal waves forecasting, especially typhoon swell forecasting before typhoon coming, and the storm surge predicted by a POM model. Data assimilation technology is incorporated for enhanced accuracy. A warning signal is presented when the storm water level that accumulated from astronomical tide, storm surge, and wave-induced run-up exceeds the alarm sea level. This warning system has been in practical use for coastal flooding damage mitigation in Taiwan for years. Example of the system operation during Typhoon Haitung struck Taiwan in 2005 is illustrated in this study.