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Simulation of coastal floodings during a typhoon event with the consideration of future sea-level rises.

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Taiwan is an Island in the western Pacific Ocean and experienced more than 3 typhoons in a year. Typhoons bring intense rainfall, high waves, and storm surges, which often resulted in coastal flooding. The flooding can be aggravated by the sea level rise due to the global warming, which may subject Taiwan's coastal areas to more serious damage in the future than present. The objectives of this study are to investigate the flooding caused by typhoons in the Annan District, Tainan, a city on the southwest coast of Taiwan by numerical simulations, considering the effects of sea-level rises according to the level suggested by the 5th Assessment Report of IPCC (Intergovernmental Panel on Climate Change) for 2050 and 2100, respectively. The simulations were carried out by using MIKE21 HD (a hydrodynamic model) and MIKE21 SW (a spectral wave model). In our simulation, we used an intense typhoon, named Soudelor, as our base typhoon, which made its landfall on the east coast of Taiwan in the summer of 2015, traveled through the width of the island, and exited the island to the north of Tainan. The reasons we pick this typhoon are that it passed near our objective area, wind field data for this typhoon are available, and we have well documented coastal wave and water level measurements during the passage of Typhoon Soudelor. We firstly used ECMWF (European Centre for Medium-Range Weather Forecasts) wind field data to reconstruct typhoon waves and storm surges for this typhoon by using coupled MIKE21 SW and MIKE21 HD in a regional model. The resultant simulated wave height and sea-level height matched satisfactorily with the measured data. The wave height and storm surge calculated by the regional model provided the boundary conditions for our fine-grid domain. Then different sea-level rises suggested by the IPCC were incorporated into the fine-grid model. Since river discharge due to intense rainfall has also to be considered for coastal flooding, our fine-grid models encompass the estuary of River Yanshui, and measured upstream river discharges were used to simulate the interactions among tide, current, and wave near the estuary of Yanshui River. Our preliminary results showed that with only the effect of rainwater discharge, the maximum surface level of the river during the storm near the estuary was 1.4 m, which is not higher than the river embankments. With the storm surge, the river level at the same location was 2.2 m. With the storm surge and sea-level rise, the maximum river levels near the estuary were 3.6 m and 3.9 m for 2050 and 2100 scenarios, respective. These levels were higher than the embankment height of 3 m. This showed that due to higher sea-level, the area near the estuary will be flooded.