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Prediction of coastal hazards and disasters on the south-eastern coast of South Korea using weather, tide-surge and damage-estimation models

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Storm surge and high waves due to typhoon generate the coastal flooding, which causes a lot of damage to the south-eastern coast of South Korea (the Republic of Korea). It is important to establish countermeasures against flooding with accurate and efficient prediction system of coastal hazards and disasters. A prediction system of coastal hazards and disasters was established by linking weather, tide-surge and damage-estimation models. The KISTI Model for Prediction Across Scales (K-MPAS), which is based on MPAS-A (Atmosphere) and optimized by KISTI for better prediction of the typhoon in the Western Pacific with the highly-resolved mesh for this area and improvements of model schemes, was used for the prediction of weather (typhoon). As a tide-surge model, the ADvanced CIRCulation model (ADCIRC) was one-way coupled to that weather prediction model to predict the typhoon-induced storm surge, current and coastal inundation. The tide-surge model used the wind and the air pressure calculated by the parametric tropical cyclone model with the typhoon track data produced by K-MPAS. The tide-surge model has a flexible unstructured mesh with the minimum mesh size of 10 m covering all flood-plains and tens of meters in the near-shore areas in the south-eastern coast of South Korea, and this mesh system was generated using highly resolved topographic and bathymetric datasets to compute flooding accurately. The damage-estimation model calculates the direct flood damage to buildings such as damage ratio of buildings, building damage costs, building contents damage, and industrial building damage in building units by using buildings information, census information and coastal inundation which is estimated by weather-tide-surge models. As a case study, the coastal hazards and disasters caused by the typhoon Chaba (201618) were simulated in terms of the storm-surge, resultant coastal inundation, and direct flood damage to buildings in the Suyeong River Area which is located at the south-eastern coast of Korea. The weather prediction model showed the good performance to predict typhoon track comparing predicted typhoon tracks with the best tracks. In general, the wind and the air pressure obtained by the parametric model were in good agreement with observations, and the storm surge was reproduced reasonably for the south-eastern coast of Korea. The building damage estimation result showed the maximum building damage ratio of approximately 24% at the tributary of Suyeong River. Future studies will extend the prediction system of coastal hazards considering not only storm surge but also wave and riverine inflow with more elaborate models and topographic/bathymetric data.