ANALYSIS OF STORM SURGE CHARACTERISTICS BASED ON TYPHOON PROPERTIES

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RESEARCH BACKGROUND

A storm surge is an abnormal sea level rise caused by low pressure and strong winds. About two-thirds of the world's population live in coastal areas with high risk natural disasters, and among them, coastal flooding caused by storm surges caused the highest number of deaths. In particular countries located in the Northwest Pacific suffer various damages from storm surge every year due to the effects of typhoons that accompany low pressure and storm winds at the same time, and Korea is no exception. So an analysis of the characteristics of storm is important tasks in disaster mitigation in coastal areas. Two approaches are commonly used for storm surge studies: dynamical method and statistical method. The dynamical approach uses a numerical model, which has the advantage of being able to reproduce the complex physical processes of the ocean and simulating the propagation and influence of storm surges, and the disadvantage of being expensive and time-consuming for modeling. On the other hand, the statistical approach using a statistical model is reasonable in cost and time for modeling, but it is greatly affected by the reliability of the input data and has the disadvantage that it is suitable only for a specific single point.

RESEARCH METHODS

Since storm surge is a natural phenomenon that is affected by typhoon characteristics (e.g. intensity, path, size, moving speed, etc.) and topographic characteristics (e.g. water depth, seabed slope, topographic complexity, etc.), this study established a statistical model by applying the multiple linear regression technique that can consider the effects of multiple independent variables. Based on the results of previous research on the coast of Korea, the study site was selected as 'Yeosu', which is expected to be vulnerable to storm surge disasters in both past and future climate conditions.

Although storm surge is affected by both typhoon characteristics and topographical characteristics, in this study, only the effects of four typhoon characteristics on the storm surge height were analyzed: intensity, path, moving speed, size. Typhoon intensity was expressed as the amount of air pressure decrease (1,030 - the minimum typhoon pressure; $\triangle pres$) and wind speed (V_{wind}). The typhoon path was expressed as the distance between the typhoon location and the point of interest which was calculated based on the typhoon location when the typhoon intensity was highest ($dist$). Moving speed ($V_{typhoon\ moving\ speed}$) as defined as the speed at which the typhoon intensity was highest. Radius of maximum wind is the distance between the center of a cyclone and its band of strongest winds, and this represented the typhoon size. In this study, among typhoons that occurred between 1979 and 2011, 44 high-intensity typhoons with the lowest central pressure of 970 hPa or less were targeted to predict the extreme storm surge height that has a great influence on the occurrence of coastal disasters. For the storm surge height (SSH), the maximum storm surge value simulated with each typhoon condition was used.

RESULTS

The statistical model derived by applying the above conditions is as follows.

$$SSH = -0.701 + 0.052 \times \Delta pres + 0.012 \times V_{wind} - 0.003 \times V_{typhoon\ moving\ speed} + 0.002 \times dist$$

The RMSE error of the statistical model was 0.136, and as a result of the model, it was analyzed that the typhoon's moving speed and the typhoon's size had no significant effect 0on the storm surge height. The model showed statistically significant results with R-squared of 93.1 %.
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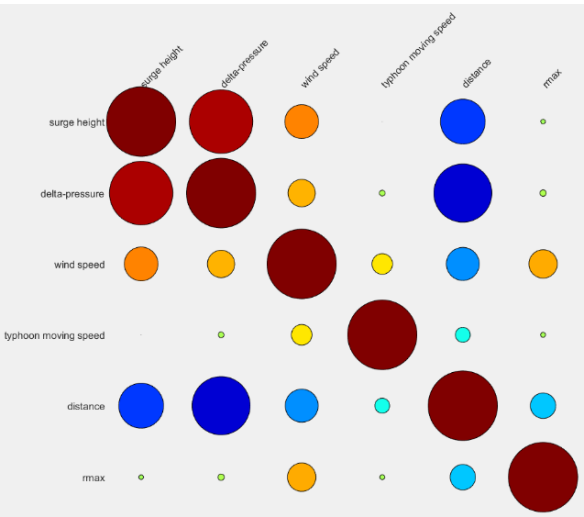

Figure 1 - Correlation between typhoon-related variables and storm surge height

Acknowledgement

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2019R1I1A1A01064178 and 2022R1C1C2009205) and by the Integrated Research Program for Advancing Climate Models (TOUGOU) funded by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT), Japan.