

Statistical Models of Typhoon Intensity and Tracking for Extreme Wind Speed Estimation

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Summary

Determination of design wind speed or wind hazard analysis for structure in general requires statistically modeled typhoon information consisting of models genesis, intensity, track and wind field. However, the current typhoon intensity and track models used to simulate the typhoons around Korean peninsula statistically have difficulties in simulating randomness and dynamics of typhoons in the study region. In this paper, more realistic typhoon intensity model and track model for the typhoons around Korean peninsula are proposed. First, defining the central pressure depth (CPD), the deficit between the central and periphery pressures as the representative of a typhoon intensity, the intensity model includes SST (Sea Surface Temperature), relative change of SST, OOR (Oceanic Occupation Ratio), relative change of OOR, latitude and traveling time. An empirical typhoon intensity model is developed by multi-variate regression. The correlation coefficients of CPDs from the present model and the RSMC best tracks for the strong and weak typhoons show 0.93 and 0.76 respectively, which shows a good agreement with the historic intensity. Secondly, a tracking model to describe dynamical typhoon tracks for the typhoons around Korean peninsula was developed. The displacements of typhoon center is determined by the mean displacement and the anomaly from the autoregression (1) model, which are estimated from the historical typhoon displacements collected on the circle with the radius of pre-assigned length scale. Classifying typhoon into the Southern Boundary (SB), the Eastern Boundary (EB) and the Western Boundary (WB) typhoons according to which boundary a typhoon enters into the domain, the spatial density correlation coefficients of the present results and the historical tracks for SB, EB, WB show 0.87, 0.6, and 0.5 respectively. The intensity and the tracking models proposed in this paper are able to reasonably simulate realistic synthetic typhoon in the point of statistical view.

Keywords typhoon intensity, oceanic occupation ratio, central pressure depth, sea surface temperature, typhoon track

1. Introduction

Recent disaster records in Korea have shown that natural disasters induced by typhoon are on the rise, and the estimation of typhoon wind speed both for risk assessment and structural design becomes more important. Generally, A Monte Carlo simulation is widely used to estimate the design wind speeds in typhoon-prone regions. The simulation includes statistical models for climatological characteristics of typhoon and physical models consisting mainly of a wind field model, a tracking model and a typhoon intensity model (Russell, 1971; Batts et al., 1980; Vickery et al., 2000). The typhoon intensity is defined by either maximum sustained wind speed or central