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Estimation on the Compound Hazard Severity of Tropical Cyclones over Coastal China during 1949-2012 with Copula Function

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The impact of global climate change on the activity of tropical cyclone remains a controversial problem in a variety of ocean basins, especially for issues like whether long-term trend exists or not in the past decades. One of the reasons is attributed to the fact that tropical cyclone system is very complex, which is unable to be described by a single indicator or parameter, such as central pressure, radius of maximum wind, maximum gust wind speed, or duration.

The potential destructiveness of a tropical cyclone is not only determined by its intensity (maximum gust wind speed), but also other parameters, especially rainfall and duration, after landing. Therefore how to integrate all the parameters together to reflect the compound hazard severity is of great importance, under the situation that some of these parameters are inter-dependent whilst others are not.

In this paper, copula function is used to describe the dependence between tropical cyclone parameters. Firstly the probability distribution functions (PDF) of all tropical cyclone parameters are fitted separately with extreme value theory, using the best track dataset of tropical cyclone over northwest Pacific Ocean from 1949 to 2012 as input. The return periods of each cyclone by different parameters are then estimated, and it can be found that the return period of one cyclone may vary dramatically by using different cyclone parameters. Secondly, in order to estimate the compound severity, the joint probability distribution is fitted with copula function by using the previously fitted PDFs of each parameter as marginal probability functions. The return periods of each landing tropical cyclone are then estimated with the joint probability distribution to represent their compound severities. Lastly, the time series of the compound hazard severity are analyzed.

It is found that the compound hazard severity, which integrates the size, intensity, duration together, can better represent the overall destructiveness of landing tropical cyclones over coastal areas.