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# Assessment of Coastal and Urban Flooding Hazards Applying Extreme Value Analysis and Multivariate Statistical Techniques: A Case Study in Elwood, Australia

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Traditionally, flood risk assessment studies have been carried out from a univariate frequency analysis perspective. However, statistical dependence between hydrological variables, such as extreme rainfall and extreme sea surge, is plausible to exist, since both variables to some extent are driven by common meteorological conditions. Aiming to overcome this limitation, multivariate statistical techniques has the potential to combine different sources of flooding in the investigation.

The aim of this study was to apply a range of statistical methodologies for analyzing combined extreme hydrological variables that can lead to coastal and urban flooding. The study area is the Elwood Catchment, which is a highly urbanized catchment located in the city of Port Phillip, Melbourne, Australia.

The first part of the investigation dealt with the marginal extreme value distributions. Two approaches to extract extreme value series were applied (Annual Maximum and Partial Duration Series), and different probability distribution functions were fit to the observed sample. Results obtained by using the Generalized Pareto distribution demonstrate the ability of the Pareto family to model the extreme events. Advancing into multivariate extreme value analysis, first an investigation regarding the asymptotic properties of extremal dependence was carried out. As a weak positive asymptotic dependence between the bivariate extreme pairs was found, the Conditional method proposed by Heffernan and Tawn (2004) was chosen. This approach is suitable to model bivariate extreme values, which are relatively unlikely to occur together.

The results show that the probability of an extreme sea surge occurring during a one-hour intensity extreme precipitation event (or vice versa) can be twice as great as what would occur when assuming independent events. Therefore, presuming independence between these two variables would result in severe underestimation of the flooding risk in the study area.