Nonlinear runoff during extreme storms in the Seolma-Cheon watershed

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Abstract

This study investigates the impact of event characteristics on runoff dynamics during extreme flood events observed in a 8.5㎢ experimental watershed located in South Korea. The 37 most extreme flood events with event rainfall in excess of 50 mm were analysed using an event-based rainfall-runoff model; the Revitalised Flood Hydrograph (ReFH) routinely used for design flood estimation in the United Kingdom. The ReFH model was fitted to each event in turn, and links were investigated between each of the two model parameters controlling runoff production and response time, respectively, and event characteristics such as rainfall depth, duration, intensity and also antecedent soil moisture. The results show that the structure of the ReFH model can effectively accommodate any nonlinearity in runoff production, but that the linear unit hydrograph fails to adequately represent a reduction in watershed response time observed for the more extreme events. By linking the unit hydrograph shape directly to rainfall depth, the consequence of the observed nonlinearity in response time is to increase design peak flow by between 50% for a 10 year return period, and up to 80% when considering the probable maximum flood (PMF).

Keywords : Nonlinear runoff, Extreme flood, Seolma-Cheon watershed, ReFH, PMF

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