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Regional and flash flood modelling of ungauged sub-basins using calibrated GIS data.

Emerging economies, such as South Africa, face severe resource constraints limiting the supply of basic services, hazard assessment and planning. In the KwaZulu-Natal (KZN) Province of South Africa, expanding informal settlements and peri-urban sprawl are encroaching into flood prone areas. The resources required to produce 1:100 year floods lines has resulted in only 1% of the total drainage length in KZN benefitting from calculated flood lines. To address the shortfall in currently settled areas alone, approximately 47 500 km of rivers need to be modelled. Here we present a method utilising existing GIS contour (10 m, 20 m), hydrological data (1:50 000) as a basis to create catchment geometry models using ArcHydro© and HEC-GeoRAS© for modelling regional flood and flash flood zones at a fourth order sub-basin level (quaternary catchments). Both regional and flash flood determination can be processed concurrently using HEC-RAS©, but using different methods of calibration and flow volume determination. Regional catchment flow volumes are derived using modified Regional Maximum Flood Peak (Francou-Rodier, 1967) equations (Kovacs, 1988). The RMF hydrographic homogenous zones incorporate aspects of geographic, climate variability and geology. Local catchment variability such as soils and land cover are ignored since RMF is based on gauged flow data and not on precipitation and run-off. On the hypotheses that the highest elevation modern flood deposits equate to the maximum flood peak (RMF), flood deposits of five quaternary catchments were mapped in the field. Model iterations were carried out using various friction values in HEC-RAS© until the best fit to the observed field data was achieved. It was found that reaches could be divided into four slope categories to which different friction coefficients could be applied. From the field calibrated flood elevation surface (RMF), the 1:100 year return period flood elevation can be derived (Kovacs, 1988). The 1:100 year flood zone modelled surfaces were compared to 1:100 year engineering flood lines and show a R^2 correlation of >0.95 for the slope categories. Flash flood flow volumes were calculated using the Rational Formula and field calibrations done using homesteads that had been affected by documented flash floods. It was found that a different set of friction coefficients were required to model flash floods. This makes the regional and flash flood elevation surfaces generated off existing data suitable for use in spatial and disaster management planning and highlighting reaches for targeted detailed modelling.