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Development Towards a Continuous Simulation Modelling System for Design Flood Estimation - Modelling Land Use Change

Thomas Rowe (1) and Jeff Smithers (1,2)

(1) Centre for Water Resources Research, University of KwaZulu-Natal, Pietermaritzburg, South Africa (tomjrowe.tr@gmail.com; Smithers@ukzn.ac.za), (2) Bioresources Engineering, School of Engineering, University of KwaZulu-Natal, Pietermaritzburg, South Africa (Smithers@ukzn.ac.za)

Design Flood Estimation (DFE) is essential in the planning and design of hydraulic structures. An increased prevalence and intensity of flooding has been identified both within South Africa and internationally. In South Africa DFE techniques are outdated and are in need of revision. Consequently, Smithers et al. (2016) initiated a National Flood Studies Programme (NFSP) to revise DFE procedures in South Africa. This study focuses on the revision and further development of a Continuous Simulation Modelling (CSM) system for DFE in South Africa, applicable to small catchments (<50 km2), using the ACRU model (Schulze, 1995). According to Smithers et al. (2016) a large majority of the catchments (55%) in South Africa for which design flood estimates are required are relatively small (<15 km2), which emphasises and justifies the need to develop such an approach. The CSM approach to DFE has advantages over traditional event-based approaches, for a number of reasons including; the explicit representation of antecedent conditions; and flood frequency analyses being performed on simulated flows and therefore the return period of the design runoff is not assumed to be the same as the return period of the design rainfall. An additional benefit of rainfall-runoff hydrological modelling, including the CSM approach, is that changes in rainfall patterns, climate in general, and land cover and catchment physiographical changes can be accounted for, i.e. through the alteration of model input variables from an understanding and conceptualisation of the changes and how they may influence hydrological processes. A component of this study is to develop land cover classes in the ACRU model to represent hydrological condition and land management practice similar, for example, to land cover classes represented in the SCS-SA model. Insight on how to represent these land cover classes is gleaned from simulations with the SCS-SA model. This paper aims to present the results from the study on the simulation of hydrological extremes and overall flows for the current representation of land cover condition in ACRU, as well as additional land cover classes. The simulations suggest that there may be a need for improvement in terms of the conceptualisation and representation of land cover changes in the model.

Keywords: Design Flood Estimation (DFE), Continuous Simulation Modelling (CSM), SCS-SA and ACRU model.