IAHS2017-23
IAHS Scientific Assembly 2017

Sensitivity analysis and regionalisation of the soil loss function within a sediment transport model by application to data scarce semi-arid catchments.

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Soil erosion threatens the sustainability of natural and man-made systems. The estimation of soil erosion and sediment transport is important for the effective management of catchments. A simple erosion and sediment delivery model for semi-arid catchments in southern Africa has been developed; however, a reduction of model parameters and further testing is required before the model can be practically applied within water resources management. The soil loss component of the model incorporates the Modified Universal Soil Loss Equation (MUSLE). The aims of the current study were to: 1) perform a sensitivity analysis and regionalisation of the erodibility parameters of the MUSLE so as to reduce the number of parameters the model user is required to set and; 2) validate the model erosion outputs for various catchments of varying conditions against other independently estimated measures. The MUSLE erodibility parameters relate to physical catchment characteristics, which are topography (LS), soil erodibility (K), vegetation cover (C) and the management practice factor (P). A regionalisation procedure to estimate the MUSLE model parameters was developed using GIS coverages. The model was applied to various catchments with a wide range of catchment conditions including climate, topography, vegetation and soils. One of the study catchments is a high erosion region in the Eastern Cape (Ntabelanga) in which a new dam has been proposed, whereas the other study regions include a small mountainous headwater catchment in the Eastern Cape and two larger headwater catchments in the North and North Eastern Cape. The sensitivity analysis indicated that erosion estimates were sensitive to the K, LS and C parameters. The model simulations of erosion were in agreement with estimates by the previous studies. The outcome of the present research is a framework for parameter estimation of the MUSLE through regionalisation which will form part of a simplified model which can estimate erosion and sediment delivery at broad spatial and temporal scales and that can be used by water resource managers with limited expertise in hydrological modelling. It is envisioned that the sediment transport model will form part of the Water Quality Systems Assessment Model (WQSAM).