

Performance of a conceptual model in a complex river system and with scarce data: Case of Letaba River system

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Abstract

The global increase in water demand has led to considerable water resource developments. The installation, maintenance and use of hydrological and supply monitoring systems however, does not often match the development and utilization levels resulting in considerable inadequacy of data for planning and operational purposes. The Letaba River system in South Africa, typical of this, overallocated (with irrigation, environmental and municipal demands), has large storage weirs that are operated by a rule-of-thumb and unmetered groundwater abstractions from an alluvial aquifer adjoining the River. There are also numerous farm dams that are partly supplied by pumping from the storage weirs. This study describes a daily conceptual model that attempts to represent the main natural and human-induced components and processes of the Letaba River. To match the limitations of data, lumping of farm dams and storage weirs and disaggregation of some of the available monthly abstractions data is done. An appropriately arranged connected-tank approach is used and split sample calibration-validation and automatic calibration using the SCE-UA is applied. The model obtains realistic sizes of the main components and satisfactorily simulates the main processes including the storage behaviour of the farm dams and storage weirs. Nash-Sutcliffe coefficient values of 0.68 and 0.78 are obtained during the calibration and verification respectively while the average percent bias is 17 % and 9.3% for calibration and verification respectively. This performance suggests the model could be applicable for operational decision support of the Letaba River.

Keywords: conceptual modelling, complex systems, data scarce, catchment processes