J. Tanner and D. A. Hughes

Surface – ground water interactions; process understanding and using models to test hypotheses.

Understanding the processes that determine the interactions between surface and ground water is crucial to the integrated management of water resources, particularly in semi-arid climates such as South Africa. The extent to which ground water processes contribute to low flows in rivers is of fundamental importance in determining the impacts on natural stream flow regimes of various water resources developments including ground and surface water abstractions. However, the processes are complex and generally poorly understood, a situation exacerbated by the dominance of fractured rock aquifers covering the majority of the country. South Africa has been using a rainfall-runoff model (the Pitman model) as a water resources management for many years, but until recently this model largely ignored the links between surface and ground water. The explicit incorporation of ground water recharge and discharge functions into the model some 5 years ago presented an opportunity to further assess the contributions of ground water to flow regimes under different climate and topographic conditions. However, assessments and applications of the new functions also require an improved understanding of processes at the catchment scale so that appropriate parameter values can be quantified. This paper presents some results of a study that has attempted to develop an improved conceptual understanding of surface – ground water interactions using the limited amount of field information (observed data) that is available. The model has been used in an uncertainty framework to assess various hypotheses and to support the development of an improved conceptual and quantitative understanding of integrated catchment scale hydrology. The paper discusses the limitations of the 'observed' data as well as the use of the model to support conceptual understanding. The conclusions are that the model, although simplified, is capable of representing the catchment scale processes that occur under most South African conditions, but that there are some specific situations that cannot be represented by the model formulation. In addition, there are some situations where quantifying appropriate parameter values for the surface and ground water components of the model is relatively straightforward, while there are others where further field-based information is required to be able to differentiate between the processes that dominate the patterns of low flow in South African rivers.