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Assessing the origin and age of groundwater with depth- a modeling approach

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Understanding the age and origin of groundwater has value in a number of areas. If land use is to be managed under the Water Framework Directive to improve water quality, then it will be important to predict the arrival times of the 'new' groundwater. Knowing the depth of penetration of solutes and their relation with surrounding landuses will assist in interpreting groundwater samples and depth profiles. However, the number and dispersed nature of solute sources and the heterogeneity of aquifers generally makes it difficult to link land-use patterns and the chemistry of groundwater discharges.

We used a simple modelling approach to link spatially and temporally variable land use with ground water flow and chemistry in three dimensions. The approach involved the use of multiple tracers, each representing a different land-use or recharge period. The computer code MT3DMS was used to track the multiple solutes in transient three-dimensional simulations. Model outputs quantified the amount of ground water from different land-use origins and time periods at any point in the aquifer. The technique was used in the River Tern catchment. The reach scale model allowed the arrival of groundwater at specific spatial locations in the channel to be identified. Upwelling flow from groundwater sources to surface waters was seen to focus upon the meander bends. Solutes were traced through the system as this method offers the opportunity for modelling the effects of surface-subsurface water exchanges on nutrient dynamics within the stream. The model highlights the spectrum of ground water from different ages. Currently the modelling approach is being used to understand the arrival times of solutes into surface water and the options for improving chemical quality by landuse change and engineering interventions as part of a research project within the

Catchment Science Centre.