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Catchment-scale modelling of flow and nutrient transport in the Chalk unsaturated zone

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The LOCAR research programme has provided a unique set of comprehensively-instrumented groundwater-dominated catchments, with the Pang and Lambourn, tributaries of the Thames near Reading, a particular focus for research into subsurface processes and surface water-groundwater interactions. The Chalk unsaturated zone is crucial in controlling the delivery of nitrate to Chalk streams, yet flow and transport processes in this complex, dual-porosity medium have remained controversial. We present results from a new dual permeability numerical model of the Chalk unsaturated zone to explore the relative roles of matrix and fracture flow, and use these to interpret detailed unsaturated zone monitoring data from the LOCAR programme in the Pang and Lambourn. A major challenge arises in representing the deep unsaturated zone within catchment-scale models for nutrient management. These have generally been based on simple conceptual stores to represent soils and groundwater. A new conceptualisation is presented and applied to the Lambourn within a catchment-scale nutrient model. Preliminary results are encouraging, but clearly illustrate the decadal time-scales that need to be considered in the context of nutrient management and the Water Framework Directive.