



Long term modelling of water quality in Chalk catchments

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The incoming European Water Framework Directive is exacerbating existing concerns regarding the status of Cretaceous Chalk catchments in the UK. Abstractions from Chalk aquifers form a significant part of the national water supply, and maintenance of good ecological status in Chalk fed rivers is important for habitat protection. Rising concentrations of key nutrients have been observed in rivers and groundwater over the past decades, linked to intensive agricultural cultivation. The medium term prognosis of trend reversal has been uncertain, due to growing evidence that the Chalk unsaturated zone highly retards chemicals. Adequate representation of this retardation is necessary for meaningful consideration of the implications of previous loadings on future concentrations. Data from two comprehensively instrumented catchments (the Pang and Lambourn, tributaries of the Thames) have been used to resolve conflicting hypotheses and formulate a parsimonious conceptualisation of flow and transport within the Chalk unsaturated zone. This has been integrated within a catchment scale model of nutrients (INCA), resulting in a new model for catchment-scale flow and transport within Chalk systems: INCA-Chalk. This model is applied to the Lambourn and used to investigate whether control of nitrogen levels can be achieved within the timescales demanded by the Water Framework Directive. Results suggest groundwater concentrations will not reduce for several decades, and that while short term improvements in river water quality are possible, increases in groundwater concentration may later reverse such improvements. If changes to land management practices do not occur, substantial increases in both groundwater and in-river concentration levels are inevitable. Climate change becomes significant by the end of this century, although scenario uncertainty leaves the direction of change unclear.