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Monitoring Flow and Nitrate Transport in the Chalk Unsaturated Zone

D.M. Keim (1), L.J. West (1), N.E. Odling (1), and PJ Chapman (2)
(1) School of Earth and Environment, University of Leeds (UK), (2) School of Geography, University of Leeds (UK)

Due to its complex dual porosity nature, flow and contaminant transport in the unsaturated zone of the Chalk are not yet fully understood. Understanding these properties and hence the range of pollutant travel times through the unsaturated zone of the Chalk is vital to predicting trends in groundwater quality. Rising nitrate levels observed in abstracted water from Chalk catchments in the United Kingdom, resulting from the development of intensive agricultural methods over the past 50 years, are one specific problem that makes narrowing this knowledge gap a priority.

In an attempt to gain insight into the hydrological processes controlling contaminant transport in Chalk a novel field monitoring programme has been established. The study site, which is situated at a rural agricultural location in Northern England, extends from the ground surface to a 30 – 55 m deep underground installation within the unsaturated zone. The soil zone has been instrumented with logging matric potential and water content monitoring devices. Three seepage sites within the 1300 m long underground installation have been instrumented with drip collection units, flow rate monitoring devices and logging fluid temperature/conductivity probes. Rainfall, soil water and seepage water are being collected and analysed for nitrate in order to gain perspective into the fate of nitrate in the deep unsaturated zone.

This intensive field monitoring programme began in Oct 2009 and will be carried out over two hydrological years. At this early stage, some preliminary examples of the data collected are being presented. The final results of the field experiments will be interpreted via mass balance approaches and modelling of unsaturated zone flow and solute transport. This unique unsaturated zone installation offers an exceptional opportunity to gain valuable insight into flow and solute transport in unsaturated dual porosity systems.