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Identifying Controls on Saturated Flow Pathways and Hillslope-Riparian Zone Residence Times Using a Combination of Tracers, Borehole Monitoring and Groundwater Modelling

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The travel time of nutrients moving through the hillslope-riparian zone continuum strongly influences the composition of stream chemistry and hence water quality. Understanding the nature of flow pathways that influence travel and residence time distributions is of particular importance for accurate process understanding and modelling of water and chemical fluxes from hillslopes and riparian zones to streams.
By combining groundwater modelling with tracer studies to directly measure travel times through a dense network of observation bores we have identified some key controls on water and chemical fluxes from a hillslope underlain by slate bedrock to the riparian zone in an upland wooded catchment.
Groundwater modelling results showed that observed hydraulic heads in the hillslope bores and flow pathways through the borefield depended on the initial depth of saturated antecedent water over the shallow slate bedrock, slate bedding plane angle and local variations in depth to bedrock. Strom event transmissivity was strongly affected by the depth of saturated antecedent water on the hillslope because the saturated hydraulic conductivity tended to decrease exponentially from the soil surface to bedrock. Chloride tracing substantiated that a small increase in initial depth of saturation led to a major decrease in mean travel time (from day to hours) but did not affect the pattern of flow pathways from the hillslope.