



## **An efficient tracer experimental design for measuring time-variable transit time distributions in periodic hydrodynamic systems**

Ciaran Harman and Minseok Kim

Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, USA

The time-varying transport dynamics of complex hydrodynamic systems with long transit times are difficult to observe even in experimental systems due to the need for multiple tracer injections. Where only one or two distinct tracers are available, overprinting in the output concentrations limits the injection frequency. We will present an experimental method (the PERiodic Tracer Hierarchy - PERTH) that allows overprinted breakthrough curves to be decomposed into contributions from multiple injections of the same tracer, so long as the transporting flow is periodic. This method allows the time varying transit time distributions to be observed efficiently while making no a priori assumptions about the transport processes operating in the system. Simulations of transport through a soil column subject to a periodic sequence of irrigation events demonstrate that the distinct transit time distributions associated with each irrigation event can be retrieved almost exactly.