Weekly CEAFM Seminar: Spring 2017

JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, February 3, 2017**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. Ciaran Harman** (EHE - Johns Hopkins University)

Title: ***"Scalar Transport in Complex Hydrodynamic Systems using a Lumped-Lagrangian Approach"***

Abstract

For many hydrodynamic systems at the scale of landscape units, like hillslopes and river corridors, the fine details of the boundary conditions controlling flow and transport (or effective upscaled properties like porous media dispersivity) are unknowable in practice, if not in principle. Nevertheless, predictions and insights regarding these processes are necessary to address a host of applied and basic questions in earth and environmental science. I will present a theoretical framework, called 'rank StorAge Selection' (or rSAS) that attempts to capture the transport dynamics that emerge in these complex systems. This provides a basis for interpreting tracer data obtained at these aggregate scales, extracting useful, concise representations of the emergent dynamics of more finely-resolved models, and developing subgrid representations that could be useful for larger scale models of solute transport. The approach is based on a 'lumped Lagrangian' model in which all spatial information about particle locations is discarded, and only age-rank in storage within a control volume is retained. A probability distribution - the rSAS function - is used to encapsulate the selection of water from storage in to discharge on the basis of age-rank. Conservative (or first-order reacting) scalar concentrations in outflow can then be predicted by convolving input concentrations with the discharge transit time distribution.

Results from a range of systems including small experimental watersheds, stream reaches and their associated hyporheic zones, an experimental lysimeter, and various simulated 'virtual experiments' will be presented in terms of this generalized framework. The results suggest ways that the structure of the transit time distributions, and their variability in time, can be related to the structure of the hydrologic system.