JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Weekly CEAFM Seminar: Fall 2012

100 YEARS
JOHNS HOPKINS ENGINEERING

Date:	**Friday, November 16, 2012**
Time:	11:00 AM
Location:	Gilman 50 (Marjorie M. Fisher Hall)
Speaker:	**Dr. Ciaran Harman** (DoGEE | Johns Hopkins University)
Title:	***"LOW FLOWS IN RIVERS: A COMPLICATED RESULT OF A SIMPLE LANDSCAPE? OR A SIMPLE RESULT OF A COMPLICATED LANDSCAPE?"***

Abstract

Though it is focused on the motion of a fluid, the central issues of watershed hydrology are rarely resolved by fluid mechanics. Uncertainties about the flows of liquid water in the landscape are complicated by spatially and temporally variable boundary conditions to such an extent that tackling them as boundary value problems has rarely been successful.

One area where such an approach has appeared to be successful is in understanding the controls on low flows in rivers. Low flows (broadly defined as those smaller than the mean annual flow), are the most frequently observed because of the skewed nature of the distribution of flow magnitudes in most (non-human regulated) rivers. Understanding low flows is critical for predicting water availability in unregulated watersheds during prolonged dry-spells and droughts, and for protecting aquatic ecosystems. The low flows in rivers are rarely constant, but rather recede after rainfall events along characteristic "recession curves", ranging from simple exponential decays to more prolonged hyperbolic curves. The apparent persistent properties of these recession curves suggest that they may contain valuable information about watershed properties.

The shapes of these curves have been "explained" in terms of the dynamics of a riparian aquifer draining to a stream. Analytical solutions to approximations of these dynamics (based on Darcian flow through homogeneous porous media) have been shown to reproduce much of the range of recession curve behavior. Consequently it has become routine to invert these recession curves to determine the properties of the effective watershed scale porous media properties, such as "hydraulic conductivity".

I will discuss an alternative model recession curves that greatly simplifies the hydraulics of the draining aquifers, and instead focuses on the effect of landscape variability. Specifically it uses an approach based on compound distributions (sometimes called "superstatistics") to connect recession behavior to the variability of the timescales dominating the draining aquifer responses. This alternate formulation is shown to be equally effective at "explaining" the range of observed recession curves, without requiring physically unrealistic assumptions about the homogeneity of landscape properties.