Ciaran Harman

Landscape evolution and the parameterization of hillslope hydrologic models.

The spatial distribution of natural soils is the result of the evolution of the landscape over many timescales. Recent theories about soil-landscape co-evolution, bolstered by advances in soil dating and topographic observation, are helping to reveal the controls on the spatial organization of surface topography and soil depth in denuding, soil-mantled hillslopes. Such theories hold out some hope that it might be possible to constrain the structure and properties of poorly observed subsurface characteristics that play such a significant role in hydrologic modeling using information on the historical evolution of the landscape. These theories may be most useful in the class of semi-distributed hydrologic models that use the organized structure of the landscape to reduce model complexity, parameter equifinality and computation time. Models such as HSB (Troch et al 2003) collapse the three-dimensional structure of hillslopes into lower-dimensional representations, allowing those aspects of their structure that dominate the storage and release of water, sediments and solutes (such as the hillslope length, slope, and catenary sequences of soils) to be explicitly modeled in a framework that can be feasibly applied to large watersheds. Combining these two advances is a challenge however, due to the fact that though there are clear feedbacks between hydrologic dynamics and soil-landscape evolution, there is a vast difference between the timescales over which each operate. In this talk I will discuss approaches to overcoming this gulf, how the processes that controls landscape evolution determine the regimes of hydrologic behaviour of hillslopes and watersheds – and vice-versa – and how the consideration of watersheds as evolved systems might improve our ability to make better predictions and incorporate more sources of data in the parameterization of hydrologic models at watershed scales.