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Finding simple ways of introducing complexity into hillslope models

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The thoughtful hydrological modeller has to worry about the difference between the complexity of the perceptual model of the processes (which only need be qualitative but includes preferential flows, strong heterogeneities, layering, irregular and permeable bedrock surfaces etc) and the limited complexity that might be identifiable from the information content of the available observations. An advantage of the REW or finite volume approach to hillslope models is that they integrate over this complexity and only require specification of the boundary fluxes. The disadvantage is that there is no theory available that will adequately deal with how the complexity and heterogeneity interacts with element scale to produce scale dependent flux closure relationships (the Hly Grail of Beven, HESS, 2006). Measurements of the relevant boundary fluxes are normally not available or are very uncertain so that any such model specification will need to rely on inference from the integral catchment discharge (and possible residence time) fluxes that are measureable. Thus complexity needs to be represented in a simple way. One way of doing this is to deal directly with water velocities in different interacting pathways. The way in which particles tracked through the hillslope system as it wets and dries can then be represented by transition probabilities for particles to change pathways. The resulting model can provide both hydrograph and travel time information in a simple, highly flexible way but poses the question of whether it can provide an adequate description of real data.