

Flood generation – process patterns from the raindrop to the ocean

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This lecture will review river flood generation processes across scales. The scale steps include pore, profile, hill-slope, catchment, region and continental scales, representing a scale range of 10 orders of magnitude. While the processes differ between scales, there are remarkable similarities. At all scales there are media patterns that control the flow of water, but themselves are also influenced by the flow of water. The processes are therefore spatially not random (as in thermodynamics) but organised, and preferential flow is the rule rather than the exception. The presence of hydrological connectivity is important, i.e. the timing when flow paths connect. There are similar controls on the flow of water at all scales, but their relative magnitudes differ between scales. The processes are linked across scales in a number of ways. Processes at all scales affect flood generation at the continental scale. Large scale processes possess emergent behaviour, i.e. they are not simply a multiple repetition of pore scale processes. At each scale transition, structure and boundary conditions are imposed. When modelling these processes, the scale transitions need to be simplified in a way that reflects the respective structures (e.g. connectivity) and boundary conditions (e.g. groundwater table). The simplifications may involve changing dimensionality (1D, 2D, 3D) of water flow. In conclusion it is argued that flood generation processes can be usefully studied at all spatial scales.