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Order, chaos and complexity in landscape evolution: insights from systems theory and social network theory

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Any physical system can exist in one of three possible states: ordered, chaotic or complex. A recently developed hypothesis relates the occurrence of these states to 1) the variability of the external conditions to which the system is subjected; and 2) the internal differentiation within the system to accommodate variations in the external conditions. This paper attempts to apply these concepts to landscapes as geomorphic systems, responding to external forces such as climate change. State variations in a geomorphic system can be observed from spatio-temporal variations in topography and morphology of a landscape, or can be inferred from temporal variations in major geomorphic metrics, such as average erosion rate or total sediment yield. Here, a numeric landscape evolution model is used to explore state variations of an idealized catchment in the context of the variability of an external signal (i.e. climate) and the internal differentiation of the catchment's geomorphic characteristics (i.e. elevation and sediment distribution).