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Stochastic Theory of Surface Erosion and River Meanders

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The mathematical theory of how the surface of the earth evolves is described. This theory is still evolving and many details need to be added but there are reasons to believe that foundation is describe by the following situation: A stochastic theory of fluvial landsurfaces has been developed for transport-limited erosion, using well-established models for the water and sediment fluxes. The mathematical models and analysis shows that some aspects of landsurface evolution can be described by Markovian stochastic processes. The landsurfaces are described by non-deterministic stochastic processes, characterized by a statistical quantity the variogram, that exibits characteristic scalings. Thus these landsurfaces are shown to be SOC (Self-organized-critical) systems, possessing both an initial transient state and a stationary state, characterized by respectively temporal and spatial scalings. The process that drives the system is turbulent flow in rivers and characteristic roughness of the surface is imprinted on it, over time, by the meanderings of the river. In particular, a single exponent Hack's exponent 4/7 characterizes the surface and produces all its scaling laws.