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Evolutionary Dynamics on Random Geologic Media Give Rise to Self-Similar Stream Networks

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The observed self-similar characteristics of stream networks have been characterized as a result of optimization processes such as minimization of the total energy expenditure. Motivated by recent developments in complex network theory, we examine the role of evolutionary dynamics in giving rise to the observed scaling characteristics. We show that non-linear evolutionary process coupled with inherent randomness of the geologic media is sufficient to create a self-similar tree organization of stream-networks that demonstrate optimality properties. This implies that minimizing the total energy expenditure is a consequence of network evolution, but not necessarily the cause of the evolution. Simulation results and detailed analyses will be presented.