Classification of Channel Network Planforms Based on Deviations from Self-Similarity

Alfonso I. Mejía and Jeffrey D. Niemann
Department of Civil Engineering, Colorado State University

Abstract. The planform geometry of channel networks can vary significantly between regions depending on the local lithologic, tectonic, and climatic conditions. This observation has led to the development of classifications such as dendritic and parallel to describe channel networks. Classification of networks has been done using both qualitative and quantitative methods. Qualitative methods rely on visual inspection whereas quantitative methods use various network attributes to determine the classification. While available quantitative methods produce more objective and reproducible classifications, they also require calculation of a large number of attributes and do not consider the role of scale in their classifications. In this analysis, we propose a simpler method to classify networks based on possible deviations from self-similarity, which is a well-documented property of dendritic networks. It is our hypothesis that several of the classical classifications of channel networks represent distinct deviations from self-similarity. We primarily consider two measures related to self-similarity: the accumulation of drainage area along a channel and the irregularity of the channel course. These two measures were estimated for fifteen samples of five network classifications: dendritic, parallel, rectangular, pinnate, and trellis. Where possible, the samples for each classification were selected because they were previously classified in the literature. As expected, dendritic networks conformed to self-similarity. The other network types deviated from self-similarity in one or two of the measures, and the forms of the deviations were distinct for each of the classifications. For example, parallel and pinnate networks seem to exhibit distinct types of self-affinity instead of self-similarity while rectangular and trellis networks exhibit distinct deviations from any type of scaling invariance. These distinct tendencies can be used to quantitatively characterize and classify channel networks.