Geophysical Research Abstracts
Vol. 12, EGU2010-7171, 2010
EGU General Assembly 2010

Tree representation of time series: A case study of self-similarity and dynamics of channel bed morphology

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We introduce a novel tree-based multiscale approach for time series analysis. A time series is represented by a tree such that each local maximum corresponds to a tree leaf; each local minimum to an internal node; and the global minimum to the tree root. The tree nodes are indexed using the Horton-Strahler indexing scheme, which is widely used to rank river tributaries. Under this ranking, the large-rank tree branches (sequences of nodes with the same rank) correspond to large-scale features of time series; while small rank branches correspond to small-scale features. We apply this technique to study the self-similar properties and dynamics of channel bed morphology, turbulent velocity fluctuations and corresponding sediment transport series as monitored in a large-scale experimental flume under different flow conditions.