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Identification of Complete Power-law Distribution of Extreme Values Using A New Multifractal Model in Eigen Space

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Extreme values (events) are often associated with anomalous phenomenon and singular processes. Detection of extreme value distribution is essential in many fields of solid earth, for example, in natural resources assessment; environmental impact and geo-hazards risk assessment etc. Small numbers of giant mineral deposits often provide the main source of mineral resources; and large earthquakes cause the major damages, just to name a few. Study of extreme value distribution has been the subject interesting not only in statistics but also in many applied fields. The common difficulty to approximate extreme value distribution is due to lack of enough data (samples) to show the complete behave of extreme values or events. Consequently there are rarely seen a compete distribution of extreme values with high level of confidence.

Although power-law distribution has been observed as a good approximation of extreme value distribution while multifractal distribution provides a comprehensive characterization of both the normal or lag-normal distribution of average values and power-low distribution of extreme values, the common multifractal models implemented in space domain are not capable of identifying the complete extreme value distribution. This paper demonstrates a new multifractal model implemented in Eigen space with which the complete power-law distribution of extreme values characterized by large eigen values calculated from a 2D map can be established. Examples of extreme values of trace element concentrations in stream sediments from mineral districts are examined for validation purposes.