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Identification on active gully erosion sites in Chinese Loess Plateau via Hilbert-Huang transform and ensemble empirical mode decomposition

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The loess shoulder-lines (gully boundary for the positive and negative terrains) are known to be the topographic structural lines in the Chinese Loess Plateau, which is most critical topographic feature in loess landform. Previous studies have shown that gully erosion activity can be strongly reflected in the dynamic changes of the shoulder-lines. The shape and variation of loess shoulder-lines reveal the soil erosion activities as well as landform evolution. A plenty of previous studies focused on analysis on the spatial statistic characteristics. However fewer considered in the apparent differences in gully area activity in different locations of in the loess shoulder-line. The interrelationship between global erosion status and local topographic attributes need to be more explorations. In this study, applying the Hilbert-Huang transform method on the height profile of the loess shoulder-lines, the active gully erosion sites along the shoulder-lines are investigated. Three typical test areas with different loess landform sub-types are selected. First, the loess shoulder-lines are derived automatically from 1-m resolution digital elevation models (DEMs). Then, active gully erosion sites are identified using the Hilbert-Huang transform (HHT) in frequency domains. The results show the success for HHT method for revealing the intrinsic characteristics of the loess shoulder-lines. The ensemble empirical mode decomposition (EEMD) and a significance test are applied to obtain the detailed information components (non-components) and trend components of the height profiles. The instantaneous frequency curve catastrophe points identified by HHT method denotes greater energy and more severe erosive processes. A field survey confirmed that the catastrophe point locations represent the active gully erosion sites. In conclusion, the method proposed in this study could potentially be effective for the exploration and analysis of geomorphological sensitivity of loess landform.