Multi-temporal runoff-sediment discharge relationships

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Abstract

To understand the runoff-sediment discharge relationship , this study examined the annual runoff and sediment discharge data obtained from the Tangnaihai hydrometric station. The data were decomposed into multiple time scales through Complete Ensemble Empirical Mode Decomposition with adaptive noise (CEEMDAN). Furthermore, double cumulative curves were plotted and the cointegration theory was employed to analyze the microscopic and macroscopic multi-temporal correlations between the runoff and the sediment discharge and their detailed evolution.

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Abstract: To understand the runoff-sediment discharge relationship in the source region of the Yellow River, this study examined the annual runoff and sediment discharge data obtained from the Tangnaihai hydrometric station. The data were decomposed into multiple time scales through Complete Ensemble Empirical Mode Decomposition with adaptive noise (CEEMDAN). Furthermore, double cumulative curves were plotted and the cointegration theory was employed to analyze the microscopic and macroscopic multi-temporal correlations between the runoff and the sediment discharge and their detailed evolution. Multi-temporal component composite models were then constructed considering structural breaks. The simulation results were compared with the actual values to examine the accuracy of the models. The results suggested that the runoff and the sediment discharge variations in the source region of the Yellow River showed reasonable consistency as a whole. However, their relationship at different time scales varied slightly. The runoff-sediment discharge double cumulative curves in the multi-temporal components exhibited high goodness of fit. The curves of the intrinsic mode function 1 and 2 (IMF1 and IMF2) components provided a more satisfactory goodness of fit, whereas distinct breakpoints were present in those of IMF3 and IMF4. The variations in the runoff-sediment discharge relationship of the raw data series resulted from the different time scales. The medium- and long-term runoff-sediment discharge relationships were insignificant, which affected the raw data series. With the help of the variable structure cointegration composite model, the smallest average relative error for the simulated annual runoff (7.82%) was obtained. This composite model could more accurately reflect the long-term equilibrium and short-term fluctuating relationships between the runoff and the sediment discharge in the source region of the Yellow River.

Keywords: runoff, sediment discharge, source region of the Yellow River, variable structure cointegration, multi-temporal scales

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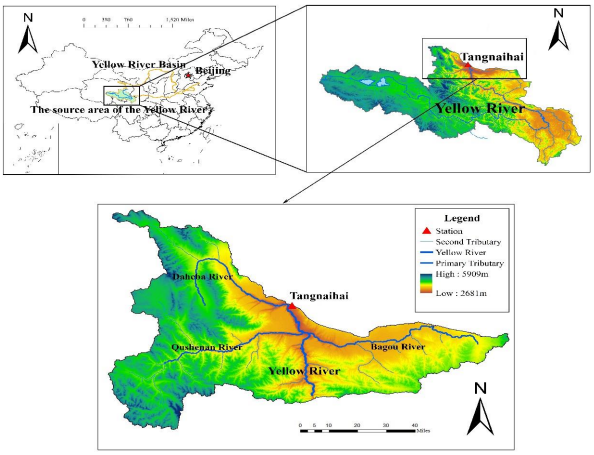

Figure 1 Location of the study area with the Tangnaihai station

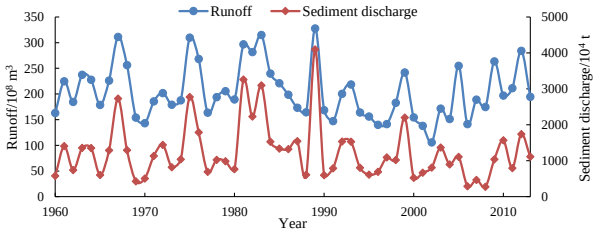

Figure 2 Variation in the runoff and sediment discharge series observed at the Tangnaihai station