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Collapse dominated landscape evolution of the Loess Plateau: Implications from a DAC-model based simulation

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The landscape of the Loess Plateau in China is distinctive in both morphological features and evolution processes, due to the erodible character of loess soil formed by the accumulation of wind-blown dust. The unique features of the landscape include: interphase distribution of plateau terraces and deeply incised channels, irregular longitudinal profiles of river channels, and tributaries joining at nearly right angles. We suppose that the loess soil is responsible for these unique features through frequent gravitational collapse and bank failure in addition to fluvial erosion. The coupled geomorphic processes include fluvial erosion, which deepens rills, gullies, and channels. Slopes/banks become steeper and unstable, and gravitational collapse occurs as the depth or slope reaches a threshold value. Due to the loose nature of the loess soil, fluvial erosion may dominate in channel evolution in the streamwise and vertical directions, while the gravitational collapse may control development in the transverse direction. To test these ideas, we adopt the DAC (divide and capture) model that is capable of taking into account these mechanisms. Two tributaries of the Yellow River, namely the Zuli River and Qingshui River in the Loess Plateau, are simulated. We can see the unique features described above from the simulation results. Our conclusion is that colluvial processes also play a major role in landscape evolution in this area, where the fluvial diffusion over the slopes is less crucial than collapse.