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GIS Grid and CWS-based assessment of vulnerability to debris flow hazards in the upper reaches of Min River, China

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Based on conceptual models of vulnerability assessment for mountain hazards, this paper aims to improve a quantitative assessment model for regional vulnerability by a detailed analysis of the relation between and among vulnerability (V), exposure (E), social coping capacity (C) and resilience (Re) with the expression of $V = E(1\text{-}\sqrt{\frac{C+Re}{2}})$. Taking the mountain settlements in the upper reaches of Min River, China, as an example and ArcGIS 9.3 as the platform, we applied the technology of GIS Grid and the method of Contributing Weight Superposition (CWS) to establish both a model and a system for the vulnerability assessment of elements at risk. The latter consists of 13 index factors including population, economics and road densities, building and farmland coverage, hazard-affected areas, a monitoring coefficient to take into account early warning measures, the urbanization rate, GDP per capita, and labor aged population ratio. Accordingly, a debris-flow hazard vulnerability zoning map has been obtained and the assessment results had shown that the distribution of high and comparatively high vulnerability zones, where economic activities are the most intensive, had a close correlation to the river geometry and geomorphology and population activities. Such results correspond well with loss data in the region, proving the reasonability and feasibility of assessment methods in this paper. The results thus may serve as the pertinent guidance for settlement relocation, population distribution readjustment, and management to prevent and reduce hazards in the upper reaches of Min River.