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AUTOMATIC EXTRACTION OF VALLEY BOUNDARY FROM DEMS IN THE HILLY LOESS PLATEAU

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ABSTRACT: As an important geomorphological divide in the hilly Loess Plateau, valley boundary plays a pivotal role in the construction of distributed models for studying the processes and mechanism of soil erosion, sediment transfer and runoffs within a watershed. In the past, this boundary manually interpreted from large scale maps and aerial photographs. In this paper, the authors first present a simple and practical definition for topographic structures unique to the highly dissected topography in the hilly Loess Plateau in DEMs; then define the valley boundary cells in a DEM with the following features: 1) they are most likely located on a concave slope, 2) these cells have the sharpest transition in slope, 3) those cells on the downward side of the valley boundary should have a slope gradient larger than 20°, 4) as the boundary of the entire valley in a basin valley boundary must be continuous; then devise an algorithm to automatically delineate valley boundary from DEMs and implement it in a computer. This algorithm was applied to detect drainage networks and the valley boundary in the Wangjiagou basin in the hilly loess area of Lishi County, Shanxi Province, China from a 10-m DEM. The extracted results are highly comparable to those manually interpreted from aerial photographs.

KEY WORDS: valley boundary; topographical features; DEM; Loess Plateau

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1 INTRODUCTION

The most remarkable topographical features in the severely eroded hilly Loess Plateau are positive (inter-valley residual tablelands) and negative (valleys) landforms. They are separated by valley boundary. Topographic features above the boundary are called plateau (yuan) and narrow hillock. Below the boundary are gully walls and valley bottoms. This boundary lies along rapidly developing rills, grooves and gullies. The dynamic variation in valley boundary is indicative of resultant lengthening of strips and expansion of valley dimension. Valley boundary has been used as a major quantitative parameter in studying the changes in the length, width, depth, and area of a valley (CHEN *et al.*, 1992). Therefore, valley boundary is a significant topographic feature in studying soil erosion and landform evolution in the hilly Loess Plateau. It is also a fundamental parameter in the construction of distributed hydrological models for a watershed.

Valley boundary has been traditionally delineated from large-scale topographic maps or through manual interpretation of aerial photographs. No attempts have been made to automatically extract it from a Digital Elevation Model (DEM). This is probably because a DEM contains only discrete elevations rather than topographic features. These elevations do not have any

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tributed models of soil erosion and hydrology. Valley boundary forms the fundamental data for constructing the models that are essential in quantifying soil erosion. Therefore, this research is a significant, first attempt towards constructing simulation models for a drainage basin.

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