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Effects of topography on vegetation function and spatial distribution in a semi-arid grass ecosystem

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It is commonly observed that topography strongly affects the state and distribution of vegetation. This topographic effect is normally considered to operate through the regulation of the incoming solar radiation and lateral redistribution of water and elements. Nevertheless, a still largely unexplored area is how plants adjust to these regulating effects relative to their location in a landscape, what are the implications for the water balance, and whether watershed vegetation-hydrology dynamics can be generalized in the form of terrain indices. In this study, we address vegetation-water-energy dynamics in a semi-arid area characteristic of central New Mexico by constructing a dynamic model of coupled transient interactions. The employed modeling system, tRIBS+VEGGIE, considers essential water and energy processes over the river basin and links them to the basic plant life regulatory processes. In a set of numerical experiments, we examine linkages between terrain attributes, patterns of vegetation productivity, and water balance components. For different imposed regimes of lateral water transfer, we identify regions of relative vegetation "favorability". We address their principal controlling mechanisms, as mediated by topographic features of the landscape, and discuss sensitivity. We find it is possible to characterize vegetation productivity and water fluxes as a function of local and global terrain properties.