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Gully erosion following wildfire in steep, mountainous terrain in the western U.S.A.

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Wildfires in forested, mountainous regions of the western U.S. are often followed by dramatic gully erosion. Extending a prior study to multiple areas, we combined GPS field mapping, interpretation of remote sensed burned area mapping, and GIS-based morphometric analysis to investigate the relationship between fire effects, topography and post-fire gully erosion. Using first-order catchments as the primary landscape unit, field mapping included the location of the gully head, the master rill head, debris fans, and other hillslope features. Remote-sensed imagery provided quantitative, spatially explicit assessment of the magnitude of the fire effects from which we derived an index of vegetation disturbance (VDI). We find a strong association between the magnitude of vegetation disturbance by wildfire as measured by VDI and the occurrence of gully erosion. Analysis of outliers indicates that the spatial distribution of fire effects strongly influences whether or not gully erosion will occur, and that the distribution patterns may have distinct, quantifiable relationships. Preliminary ternary graphing of slope, contributing area, and VDI suggests correlation trends where the three measures co-vary, indicating an interaction between the effects of topography and fire effects in catchments where gully erosion occurs. Thus the magnitude, location, and patch-patterns of fire effects may contribute to the variability of slope-area relationships reported in the literature, and the location of channel and gully heads in mountainous terrain. The importance of the spatial arrangement of fire effects offers new insight into the role of hydrologic connectivity in the erosion response. The VDI method to quantify vegetation disturbance may offer a standardized method to assess geomorphic response to vegetation change from other disturbance processes and over large landscapes. In our ongoing research a 1m digital terrain model from LiDAR is being used to assess the relative importance of curvature versus slope as an indicator of the potential for post-fire gully erosion.