Effects of Gully Topography on Space-Time Patterns of Soil Moisture in a Semiarid Grassland

Joshua J. Melliger and Jeffrey D. Niemann
Department of Civil and Environmental Engineering, Colorado State University, Fort Collins, CO

Abstract. Gullies are pervasive topographic features in semiarid grasslands in North America. At the Army's Piñon Canyon Maneuver Site (PCMS) in southeastern Colorado, gullies are important because they restrict the mobility of troops and vehicles in training exercises, and they represent areas that are potentially vulnerable to further erosion. Substantial research has examined the temporal evolution of gullies as well as the factors that initiate gullies and control their morphology. In particular, prolonged periods of low soil moisture (droughts) are thought to reduce vegetative cover and promote gully development. Much less is understood about the feedback of gully morphology on space-time patterns of soil moisture. The presence of gullies may lead to feedbacks to soil moisture that either enhance or diminish gully development. In this study, field observations from PCMS are used to study the effects of gully topography on space-time patterns of soil moisture. Two study sites at PCMS have been extensively instrumented. Both sites are located in the same broad valley, but one site (~1200 m^2) is ungullied and the other site (~3800 m^2) contains two approximately parallel gullies. At each study site, hourly soil moisture observations have been collected for 8 months using time-domain reflectometry (TDR) probes installed along four transects. Each transect contains 8-13 probes that are positioned at the mid-points between topographic breakpoints. Meteorological data are also collected at each study site. Spatial average soil moisture values tend to be similar when comparing the valley side slopes at the ungullied study site and the valley and gully side slopes at the gullied study site. Similarly, spatial average soil moisture values tend to be similar when comparing the valley floor at the ungullied study site and the gully bottoms at the gullied site. The valley and gully bottoms are typically wetter than any type of side slope.