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UAV based soil moisture remote sensing in a karst mountainous catchment

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Spatial distribution of soil moisture (SM) is a prerequisite for research and management of agriculture and ecology. However, it is still a challenge to retrieve SM data in highly heterogeneous landscapes. By investigating environmental factors (soil, vegetation and topography) and comparing different remote sensing sources (Landsat-8, Radarsat-2, ASTER Global Digital Elevation Model (DEM) V002 (ASTGTM2), unmanned aerial vehicle (UAV)) for karst mountainous catchments of southwest China, this study identified key controlling factors on the spatial distribution of SM and built a remote sensing model for SM estimation in highly heterogeneous landscapes. Results showed that vegetation type (35.7%), aspect (7.7%), height index (4.2%), soil bulk density (3.3%), soil total nitrogen (3.1%), aspect interact with vegetation type (3.4%) and soil total phosphorous (1.3%) totally explained 58.8% of the SM variability. The correlations between SM and topographic derivatives varied with DEM resolutions (1 - 50 m), and generally reached their highest values at 7 m for height index, slope gradient, and aspect, 16 m for flow accumulation and topographic wetness index, and 43 m for curvature. Partial least-squares regression analysis showed that optical and infrared bands from Landsat-8 and topographic derivatives from UAV photogrammetry DEM were more strongly correlated with SM than other datasets. An empirical model (SM = 9.27 * (10)ˆ(-2) HI - 1.82 * (10)ˆ(-5) B5 + 0.519) with only height index and B5 band from Landsat-8 as inputs is proposed, as it shows acceptable performance (R2 = 0.36; RMSE = 0.076). The results of this study provide useful information for SM remote sensing in karst mountainous area and similar heterogeneous landscapes.