Evaluating Geospatial Variants of USLE Topographic and Cover Factors

Abstract

Accelerated soil loss is a major problem threatening natural and cultural resources in the arid Southwest. Accurate assessment of the scale of erosive processes is essential for making sound resource management decisions. While the Universal Soil Loss Equation can be used with flexibility in a GIS environment to estimate soil loss, the number of factor calculation methodologies leave uncertainty as to the most appropriate method. This study used varying methodologies for calculating the USLE S (slope inclination) and C (land cover) factors using remotely sensed data and evaluated their suitability using a comparison between a 1965 aerial photogrammetric survey and 2013 site conditions using digital close-range photogrammetry. Photogrammetric models were georeferenced to the project coordinate system using reflective targets measured using an electronic theodolite. The 2013 survey sampled approximately 14,000 square feet at five sites within the study area, finding a mean vertical decrease of approximately 0.24 feet and net soil loss of approximately 3,333 cubic feet over the course of the 48-year period of study. With the exception of one sample site, model predictions underestimated soil losses as measured.

The study compared three C (land cover) factor calculation techniques published by De Jong (1994), Van der Knijff et al. (1999), and Suriyaprasit and Shrestha (2008), as well as three methods for calculating the effect of slope inclination, published by McCool et al. (1987), Nearing (1997), and Mitasova and Mitas (1999). The study found that the values calculated by Van der Knijff et al. (1999) equation generally contributed to estimates with higher levels of
agreement with field. A possible explanation for this is the history of soil disturbance at the study site. C factor calculation technique was identified as the most important decision for future soil loss estimates at the site. While the S factor equation of McCool et al. 1987 was included in the variant with the highest levels of agreement at the sample site and slope unit scales, the differences between all three S factor methodologies were small and generally contributed to similar estimates. The study was able to identify a combination of remotely sensed parameter calculation equations which yielded soil loss estimates superior to those of other equations tested.