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Photogrammetrically measuring dryland soil erosion from a UAS platform

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ABSTRACT:

Soil and site stability are key attributes of assessing the health of rangelands because these lands are susceptible to high rates of wind and water-caused erosion. Accordingly, monitoring the severity, spatial extent, and rate of soil erosion is essential for long-term sustainable management. Field techniques for measuring and monitoring soil erosion in rangelands are often labor intensive and require many field visits. As a result, these field methods usually cover only small areas. There is a growing effort to monitor natural resources at broad scales which is driving the need for new soil erosion monitoring tools. One remote-sensing technique that could be used to measure soil movement from aerial imagery is digital elevation model (DEM) differencing where a DEM of the land surface is created using aerial photogrammetry methods at multiple points in time. By geographically co-registering the DEMs and subtracting one surface from the other, an image of soil elevation change can be created. Such analysis would allow quantification and visualization of soil erosion, deposition, and redistribution.

We tested the use of high-resolution DEMs to model the soil surface of Chihuahuan Desert shrublands located near Las Cruces, NM, USA. We acquired 20 overlapping aerial images from a BAT 4 unmanned aerial system (UAS) for six 50 x 50m test plots. The imagery was taken with a 21 megapixel Canon EOS 5D digital SLR camera at 152 m above ground level yielding a ground sampling distance of ~3cm. From the imagery, we created 5cm spatial resolution DEMs of each of the plots. Preliminary results showed a strong agreement between elevation profiles measured from the DEMs and profiles measured with a ground-based laser range finder slid along an erosion bridge. The DEM method has a distinct efficiency advantage for broadly characterizing soil erosion compared with field methods and could be integrated into existing monitoring programs.