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DEM Resolution Comparison for Landslide Vulnerability Analysis:
Catalina Island Field Study

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INTRODUCTION:

This study examines the hillside north of the USC Wrigley Marine Science Center to compare DEM spatial resolution suitability for landslide vulnerability analysis. UAS photogrammetry has enabled the extension of previous landscape research[1,4] by investigating phenomena at finer resolutions. As drone imagery becomes more ubiquitous in landscape analyses, research is needed to determine application-specific resolution requirements. Determining an appropriate DEM resolution for landslide vulnerability analysis is necessary for land management, property destruction mitigation, and loss of life prevention. This study aims to identify the most effective DEM resolution for landslide vulnerability analysis and is used to indicate possible future collection methods for Catalina Island.

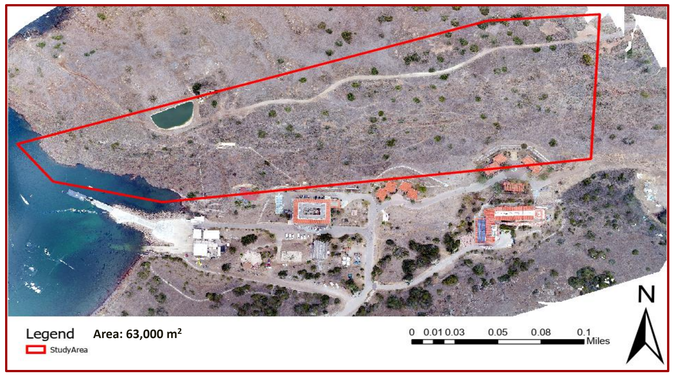

Figure 1. Study Area

METHODS:

Data Collection:

- UAS collection #1 (east-west grid pattern, camera at 45º)
- UAS collection #2 (east-west grid pattern, camera at 90º)
- UAS collection #3 (north-south grid pattern, camera at 45º)
- GCP collection with RTK and ArcGIS Field Maps

Figure 2. Phantom 4 UAS

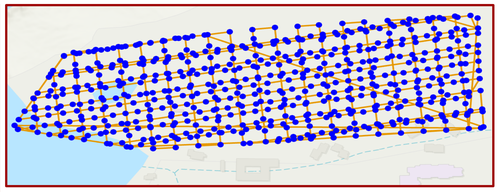

Figure 3. UAS collection #1, #2, #3 flight pattern

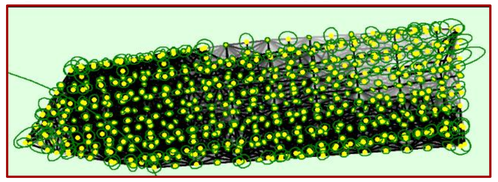

Figure 4. Image matching of UAS collection #1, #2, #3

METHODS (continued):

Processing:

- Processed Drone2Map DEM (DSM and DTM)
- Weighted Overlay Analysis in ArcGIS Pro [2,3], performed at 10 different spatial resolutions: Slope + Water Flow + NDVI [5] = Landslide Vulnerability
- Converted rasters to feature class polygons
- Counted number of polygons per resolution to measure of noisiness

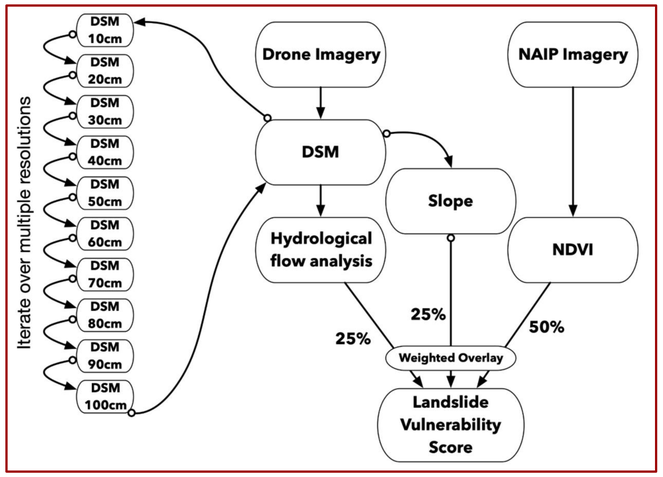

Figure 5. Model using UAS & NAIP imagery

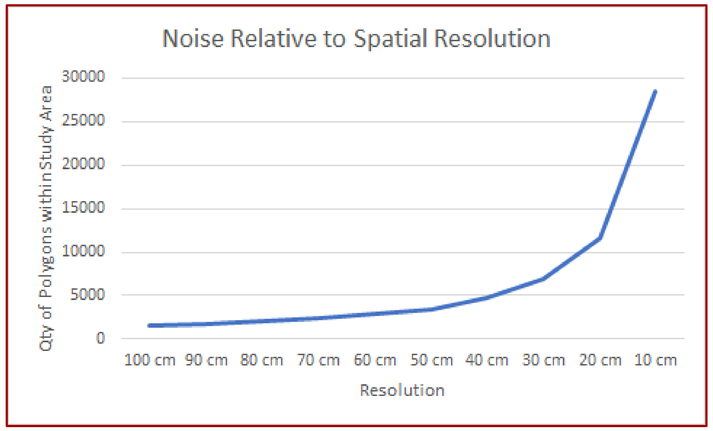

Figure 6. Resolution vs. Quantity of Polygons

RESULTS:

Our analysis revealed that there is a strong positive correlation between noise and spatial resolution. As the spatial resolution increased (became more fine) so did the number of unique polygons (Figures 6 and 7).

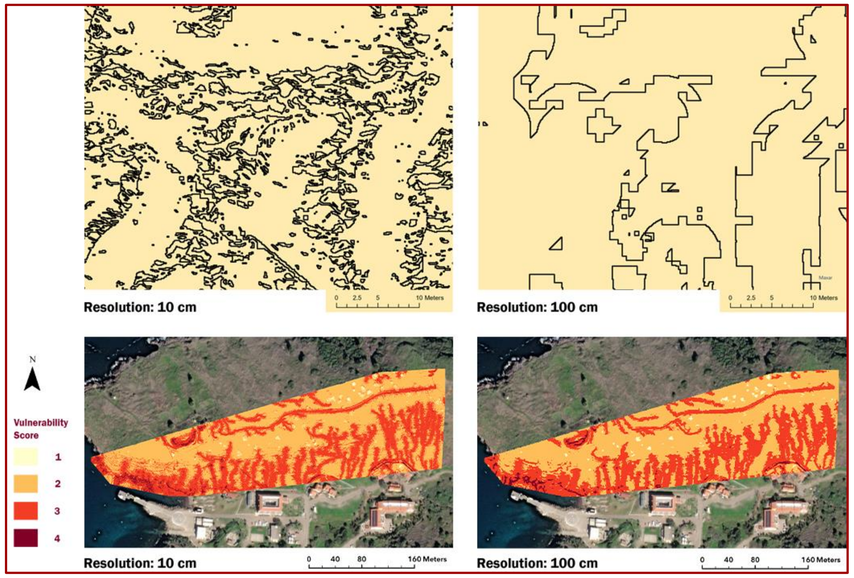

Figure 7. Visualization of polygons at 10 cm and 100 cm resolutions. Score of 1 represents low vulnerability

DISCUSSION/CONCLUSIONS:

With consideration to landslide vulnerability analysis, finer spatial resolution of the DSM does not add any additional information. All actionable patterns visible at the finer 10 cm resolution are also visible at the coarser 100 cm resolution. Additionally, 10 cm resolution results in more noise, higher computation times, and greater data storage costs compared to 100 cm resolution results. Thus, we recommend that for further study of landslide vulnerability on Catalina Island, data at 1m resolution is sufficient. General study limitations include a narrow GSD range, confined study area, and a fixed spatiotemporal resolution for NDVI data. Based on these limitations, future studies could explore broadening GSD range (> 1m) and increasing study area size for additional insights. Results are consistent with previous studies on resolution impacts on landscape pattern studies[4]. Sources of error include operator, GPS, and sensor errors. While results indicate finer spatial resolutions do not add additional value for this application, varying resolutions may offer benefits for other studies and should be considered based on study goals.

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