Abstract

Caves historically have been one of the most difficult types of terrain for mapping and data acquisition due to the inability to use satellites, aerial imagery, or even accurate GPS receivers. Karst science typically relies on outdated survey methods, but advances in technology which allow for 3D models of terrestrial objects and terrain, are slowly making their way into Karst science. The most accurate method of remotely scanning areas and collecting accurate data, light detection and ranging (LiDAR) produces impressive and accurate 3D models and even detects sub-canopy elevation changes. However, its prohibitive costs and processing requirements make it unavailable to many. Close-range photogrammetry (CRP) is an affordable alternative given cost, but at the loss of accuracy in the 3D model produced.

While CRP with geo-referenced imagery can be used to produce 3D models of terrestrial landscapes and objects or "floating" subterranean objects, there are few studies that have utilized CRP in the entirety of an enclosed cave environment. This study examines a previous methodology used to create 3D models of terrestrial caves as a way to model underwater cave systems as well as terrestrial systems. The aim is to validate this methodology and apply it to different systems, with minor necessary adjustments. The photogrammetry data collection process utilized a GoPro Hero 5 camera and floodlights to collect imagery, which were processed using Agisoft PhotoScan Professional. High accuracy GPS receivers were used to collect cave entry coordinates to produce georeferenced models that were imported into ArcGIS. Traditional surveys were conducted to compare models. The methodology requires further modification and technical diver training to produce 3D models successfully of underwater cave systems via photogrammetry. Using a modified version of Jordan's (2017) methodology produced promising results and 3D models of the terrestrial caves.