Metadata Report

Project Name SfM model of McKittrick Canyon Reef trail stratigraphic section – Guadalupe Mountains National park (2018)

Summary

Dataset includes SfM point cloud of northeastern edge of McKittrick Canyon in Guadalupe Mountains national park. Point cloud spans portions of the reef trail, extending from carbonate ramp/slope deposits, to overlying massive reef (large cliffs), and backreef deposits (flat layers with overhangs).

SfM photographs were collected with handheld 55mm zoom lens DSLR camera in May, 2018. Photograph locations were geotagged using an Arrow gold GPS unit to 3D accuracy of ~2 m.

Bare-earth airborne lidar dataset was used as reference cloud in iterative closest point alignment in CloudCompare V2.12: https://doi.org/10.5069/G9BK19G8. No vegetation filtering or clipping was performed on SfM derived point cloud.

M3C2 cloud-to-cloud difference between lidar point cloud and SfM point cloud with default parameters and SfM model as cloud 1 yields 1-sigma cloud-to-cloud difference of 0.96 m and 2-sigma cloud-to-cloud difference of 2.38 m. Lidar point cloud contains significant large holes in cliff overhang locations.

Accuracy is likely not sufficient for change detection analysis but is sufficient for morphometric analysis and stratigraphic mapping.

Link to reference airborne lidar point cloud collected as NCALM seed grant to Neely (2016): https://doi.org/10.5069/G9BK19G8

Useful paper describing stratigraphy across region covered by SfM model:

(Tinker, 1998) https://doi.org/10.2110/jsr.68.1146

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Site Information

- Description: Guadalupe Mountains National Park (TX), McKittrick Canyon. SfM model covers all stratigraphy traversed by Permian Reef Trail: Carbonate ramp/slope, Massive Reef, and Backreef stratigraphic units.

- Objective: (1) Map geometric relationship of stratigraphic units. (2) Provide 3D model that can link to field photographs of outcrops and fossil assemblages from the Permian Reef trail. Model can be used for remote teaching or outreach exhibits in combination with lidar topography and field photographs. (3) Model used to describe bedrock fracture density and orientation in cliff forming units – relevant for geomorphology and structural geology work.

- Site location and structure-from-motion model georeferencing accuracy (below)

Location: McKittrick Canyon, Guadalupe Mountains National Park, TX

Georeferencing accuracy:

- Georeferenced to airborne-lidar point cloud (https://doi.org/10.5069/G9BK19G8)
- M3C2 cloud-to-cloud difference with default parameters
    - 1-sigma cloud-to-cloud difference = 0.96 m
    - 2-sigma cloud-to-cloud difference = 0.2.38 m

- Site conditions: dry, May, 2018, consistent bright lighting conditions.

Survey Results

- Photos recorded with 55mm Nikon zoom lens D5500 DSLR camera

- Camera specifications:
    - Lens: 82 mm (35 mm format equivalent) f/8
    - 6000x4000 pixel sensor

- 55 mm focal length, distance of approximately 1 km from target scene

Products

- Collection date: 5/10/2018
- Coordinate system: Horizontal datum (NAD83, UTM13N) EPOCH:2010, EPSG: 6342, Vertical datum (EPSG:5703)
- Spatial resolution: spatially varies
- Accuracy reported as cloud-to-cloud difference with lidar point cloud
- Data formats: .laz
- Data processing methods:

- Structure-from-motion rendering performed in AgiSoft Photoscan V1.1
- Photos were geotagged with camera station GPS position from EOS arrow GPS unit (3D rms <2 m)
- Photos not clipped or cropped. Imported to AgiSoft Photoscan as .jpeg
- Alignment performed on “high”, 40000 keypoint matching, 10000 tie point matching, reference preselection with GPS positions of each photo geotag. Adaptive camera fitting model.
- Min photo projections = 4 photos/keypoint
- Dense cloud constructed on “high” with “aggressive” depth filtering
- Dense cloud was exported from AgiSoft Photoscan as .las file to CloudCompare where “align” tool was used to fine-scale align structure-from-motion model dense cloud and bare-earth point cloud derived from aerial lidar platform. No vegetation filtering was performed on dense SfM-derived cloud. Cloud-to-cloud difference was computed with M3C2 algorithm with default parameters using SfM model as cloud 1. Aligned structure-from-motion point cloud was exported as .LAZ file.