OpenTopography Metadata — Gualan, Guatemala

Dataset Name (citation title): UAV Lidar Survey near Gualan, Guatemala, January 2024 **Collection Platform:** Airborne Lidar **Data Products:** Point Cloud + Raster (DTM)

Summary

This flight was part of a multi-day, multi-site lidar survey of various points along the Motagua and Polochic Faults in Guatemala. UAV-based lidar survey of Gualan, Guatemala, part of the 2024 Spring Campaign conducted by Missouri S&T under an NSF planning grant led by J. Obrist-Farner and Jeremy Maurer to collect and analyze high-resolution topography data along several points of the Polochic-Motagua Fault System (PMFS). The lidar data was collected to be used for analyzing fault offsets and identifying locations that might be suitable for trenching, as well as better understanding the fault system.

Personnel

- PI(s): J. Maurer
- Field staff: T. Niemi, C. Grützner, O. Flores
- Additional team members: J. Obrist-Farner

Site Information

- Description: Gualan, Guatemala
- Objective: Collect lidar data using the Quantum Systems Trinity F90+ for processing to point clouds and DEMs/DTMs
- Location (approx. center): **15.1289 N, −89.3272 W** (UTM 16N)
- Conditions: Very hot and humid, sunny. Very windy.
- Date(s) on site: 2024-01-23

Survey Results

- Equipment used: Quantum Systems Trinity F90+ VTOL fixed-wing UAV carrying a YellowScan Qube 240 lidar payload
- GNSS solution: Ground base station with a u-blox ANN-MB-02-00 multi-band active GNSS antenna; base position fixed by CSRS-PPP (NRCan, ITRF20). UAV trajectory PPK-processed relative to the base. Base-station RINEX + PPP reports archived per site (coordinates in base_station_ppp.csv); see absolute accuracy below.
- Errors / accuracy:
  - Relative: Relative (strip-to-strip, 3-D) RMSE 8.2–10.5 cm (post-adjustment, YellowScan CloudStation, 3 flights / 32 flight-line exports).
  - Flight-to-flight (after co-registration): flight 211849 agrees with flight 220238 to **median −0.1 cm, NMAD 5.5 cm, RMSE 12.2 cm** over 475,963 1 m ground cells (~0.48 km²). See `Gualan/gualan_coregistration_report.md`.
  - Absolute: Absolute georeferencing via CSRS-PPP base station(s) (QS023T00, QS023U00), 95% CI: horizontal ±2.7–2.8 cm, vertical ±7.5–7.8 cm (fixed-ambiguity PPP solution). Datum ITRF20 (2024.1); ellipsoidal heights (the CGVD2013 orthometric height in the PPP report is a Canadian geoid and is NOT valid in Guatemala).

- Alignment: Boresight-calibrated strip adjustment (YellowScan CloudStation, Precise method); per-flight reports in each flight's 'Strip Adjustment' folder. **Additionally, flight 211849 was re-levelled by co-registration** — see "Re-processing and co-registration" below.
- Collection method: Flown at ~100 m constant altitude above the base station (single flight height, no terrain-following). Missions planned and executed in Qbase (Trinity mission-planning software). 32 flight-line export(s) across 3 flights.

Re-processing and co-registration

Flights 204440 and 220238 were re-processed in YellowScan CloudStation in July 2026 and are the authoritative versions delivered here. Flight 211849 could **not** be re-processed — its original raw data files are no longer available — and the surviving export carried a large vertical blunder (~13 m) from an uncorrected autonomous base-station height.

That flight was therefore re-levelled by co-registering its ground surface to the re-processed flights. A pure 3-D translation of **Δx = −4.460 m, Δy = −0.920 m, Δz = −13.307 m** was applied. Ground-surface agreement improved from median −13.298 m / NMAD 0.634 m to **median +0.0001 m / NMAD 0.056 m**. The shift is stable across independent spatial blocks (1σ: Δx 8.2 cm, Δy 0.9 cm, Δz 1.4 cm) and leaves no significant tilt (≤5.7 cm/km).

Caveats a user should know: - The alignment is anchored almost entirely to flight **220238**. The three flights form a SW→NE chain with 211849 in the middle. - The tie between 211849 and **204440** rests on only 131 ground cells (a ~13 × 16 m patch at the outer swath edge of both), over which the aligned 211849 sits **+39.6 cm** above 204440. This is too small a sample to act on, but it is a real, repeatable signal. - Flights **204440 and 220238 do not overlap each other at all**, so their mutual consistency cannot be verified from the data; both are trusted because they used the correctly-processed base station.

Full method, metrics and validation: `gualan_coregistration_report.pdf`.

Products

- Date of collection: 2024-01-23
- Horizontal CRS: **WGS 84 / UTM zone 16N (EPSG:32616)**
- Vertical: ellipsoidal height (WGS 84), no geoid applied
- Vertical CRS / EPSG: WGS 84 ellipsoidal height — **EPSG:4979** (3D geographic; no geoid)
- **CRS as encoded in the delivered LAZ:** plain **EPSG:32616** (2-D), written as an OGC WKT VLR, matching every other dataset in this campaign. The vertical reference is ellipsoidal height, documented here and in the submission-form fields below rather than encoded in the file. An earlier build of these files carried a compound CRS (`WGS 84 / UTM zone 16N + Ellipsoid (metre)`); it was replaced because EPSG defines no code for UTM 16N with ellipsoidal height, so that CRS had no authority code of its own and consumers scraping the WKT resolved it to EPSG:9001 (metre — the axis unit) instead of the projection. Plain EPSG:32616 resolves correctly by every route.
- Spatial extent (UTM): X 248044–251754, Y 1672317–1675507 (~11.83 km² bounding box; **~4.53 km² actual data footprint** — the three flights form a SW→NE chain, so the bounding box substantially overstates coverage)

- Total points: **540.4 million** (540,401,462; ~119.3 pts/m² over the 4.53 km² data footprint, ~45.7 pts/m² if averaged over the bounding box)
- DTM resolution: 0.5 m
- Data formats: LAZ (point cloud), Cloud-Optimized GeoTIFF (raster)
- Processing: YellowScan post-processing (trajectory + point-cloud generation) → LAZ; DTM gridded from ground-classified returns

Files in this submission

Point clouds — 3 flights in 4 LAZ files, LAS 1.4 point format 7, CRS **EPSG:32616** (ellipsoidal heights; see CRS note above). Flight 211849 is delivered as two contiguous, non-overlapping spatial tiles (split at easting 249,440 m) to stay under OpenTopography's 2 GB per-file limit: - `gualan_lidar_pointcloud_20240123-204440.laz` (58,269,110 pts; Z 116.9–208.0 m; point_source_id 1001–1006). Re-processed July 2026; extracted from the merged CloudStation export. - `gualan_lidar_pointcloud_20240123-220238.laz` (207,608,260 pts; Z 106.9–233.7 m; point_source_id 2001–2013). Re-processed July 2026; extracted from the merged CloudStation export. - `gualan_lidar_pointcloud_20240123-211849_aligned_tile1of2.laz` (137,268,188 pts; west half, easting < 249,440 m; Z 108.2–214.9 m; point_source_id 3001–3013) - `gualan_lidar_pointcloud_20240123-211849_aligned_tile2of2.laz` (137,255,904 pts; east half, easting ≥ 249,440 m; Z 107.9–214.5 m; point_source_id 3001–3013)

Flight 211849 (both tiles; 274,524,092 pts total) is **co-registered** to the two flights above (Δx −4.460, Δy −0.920, Δz −13.307 m). Its original point_source_ids were 1001–1013, which collided with flight 204440′s; they were renumbered +2000 so the files can be merged without ambiguity. The 2 undocumented extra bytes per point in the source LAS (no ExtraBytes descriptor VLR) were dropped on rewrite.

Raster (DTM): `gualan_dtm_cog.tif` (0.5 m, Float32, Cloud-Optimized GeoTIFF, EPSG:32616; NoData = −99999; Z 106.95–223.46 m). Regenerated from the ground-classified returns of all three flights *after* co-registration; small voids filled to a 10-pixel (5 m) radius, giving 96.8 % fill within the data footprint. This **supersedes** `Results-DEMs/Gualan/merged_Gualan.tif`, which predates both the re-processing and the co-registration.

Supporting files: - `gualan_coregistration_report.pdf` (method, error metrics, validation, caveats) - `gualan_data_footprint.geojson` (actual data footprint, EPSG:32616) - `gualan_survey_polygon.kml` (planned survey boundary — two segments along the fault trace)

OpenTopography Community Dataspace — submission-form fields

Spatial reference - Horizontal Coordinates: WGS 84 / UTM zone 16N - Vertical Coordinates: Ellipsoidal WGS-84, no geoid applied - Horizontal EPSG Code: 32616 - Vertical EPSG Code: 4979

Other information - Survey Date (MM/DD/YYYY): 01/23/2024 - Area (m²): 4,530,000 (= 4.53 km², actual data footprint; bounding box is 11.83 km²) - Point Density (pts/m²): 119.3 - Raster Resolution: 0.5 m - Metadata Document File: Gualan_metadata.pdf

Descriptive / administrative - Use License: CC BY 4.0 - Dataset Keywords: lidar; airborne lidar; UAV; drone; Guatemala; Polochic-Motagua Fault System; active tectonics; tectonic geomorphol-

ogy; fault scarp; paleoseismology; DTM - Funding Support: NSF planning grant, J. Obrist-Farner & J. Maurer (Missouri University of Science & Technology) — 2305799 - Dataset Acknowledgement: Data collected under an NSF planning grant (Obrist-Farner & Maurer, Missouri S&T). Field team: T. Niemi, C. Grützner, O. Flores, J. Obrist-Farner. - User Contact Information: Jeremy Maurer, Missouri S&T, jmaurer@mst.edu