OpenTopography

Metadata Report

Project Name

Drone lidar surveys of the Tintina Fault near the Dempster Highway, Yukon, Canada, September 2023

Summary

Three drone lidar surveys were conducted over the Tintina fault, near its intersection with the Dempster Highway in the Klondike region of the Yukon Territory, Canada. The data were collected to map and better constrain the kinematics and timing of Quaternary surface rupturing earthquakes on the Tintina fault. A Riegl MiniVux1-UAV laser scanner and an Applanix APX-20 UAV IMU mounted to a DJI Matrice 600 Pro drone were used to collect the dataset. More information about the platform can be found in Salomon et al. (2024). More information about this specific study site on the Tintina fault will be in a forthcoming paper by Finley et al. (2025?).

Personnel

- PI: Theron Finley[1], Edwin Nissen[1], John Cassidy[2]
- Field Staff: Guy Salomon[1]
- Other Team Members: Roger Stephen[3]

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Site Information

- Site description

Three segments of the Tintina fault were surveyed near kilometer 8 on the Dempster Highway:

  - Northwest – 1300 m long by 400 m wide. This survey is located on a glaciofluvial outwash terrace immediately northwest of the Dempster Highway. Drone was launched from a bush road adjacent to the highway.
  - Central – 1100 m long by 550 m wide. This survey is located on a terminal moraine on the southeast side of the North Klondike River, accessed via the North Fork East Road. Drone was launched from a Tr’ondëk Hwëch’in camp facility.
  - Southeast – 1100 m long by 250 m wide. This survey is located on a glaciofluvial outwash terrace southeast of the North Fork East Road. Drone was launched from a pull out on the North Fork East Road.

- Site objective

The general objective of these surveys was to produce high resolution DTMs along the Tintina fault so as to better understand the kinematics and timing of paleoseismic ruptures.

  - Northwest – Objective was to measure vertical separation of glaciofluvial terrace surface, and lateral separation of terrace riser.
  - Central – Objective was to determine if any subtle fault scarps deform the moraine.
  - Southeast – Objective was to measure vertical separation of glaciofluvial terrace surface

- Site location (GPS cords and/or map)

Approximate centroid coordinates for the three surveys are provided:

  - Northwest: 64.0141, -138.6206°
  - Central: 64.0011°, -138.5816°
  - Southeast: 63.9863°, -138.5394°

- Site conditions

Leaf-on conditions in late summer. Central and Southeast surveys had strong wind gusts.

- Date/time spent at each site
  - Northwest – Sept. 8, 2023. 1 day (approx. 6 hours)
  - Central – Sept. 9, 2023. 1/2 day (approx. 4 hours)
  - Southeast – Sept. 9, 2023. 1/2 day (approx. 3 hours)

Survey Results

- Equipment used

Drone lidar system includes a Riegl MiniVux1-UAV laser scanner and an Applanix APX-20 UAV GNSS-inertial measurement unit mounted to a DJI Matrice 600 Pro drone. Ground control was collected using two Trimble R12 units in a base and rover configuration.

- GPS solutions

Local base data was collected by our Trimble R12 base station, which ran for the duration of surveying. The base rinex file was processed using NRCANs Precise Point Positioning tool.

- Errors

Flat surfaces in the point cloud have a scatter of approx. 20 cm.

- Alignments

Alignments of the point clouds was done using the RiPrecision Tool within the RiWorld processing workflow. These alignments make use of collected GCPs as well as attempt to resolve planar differences between individual flight line point clouds. Note that there are some linear alignment artifacts in the data that should not be confused with real linear features.

- Collection methods

Flight plans were created with Universal Ground Control Station (UgCS). The drone was flown at 80 m AGL and at speeds of 4 m/s. Harlequin-cross style targets were used as ground control for each site. Flight lines were generally parallel to the fault. Calibration lines were orthogonal to the flight lines. Field crew consisted of one Pilot in Command and two designated Visual Observers to ensure Visual Line of Site was maintained throughout the survey.

Products

- Date of dataset collection

September 8th and 9th, 2023

- Coordinate system of datasets

Horizontal coordinate system: EPSG 3154 - NAD83(CSRS) / UTM 7N
Vertical Datum: CGVD2013(CGG2013a) Orthometric Elevation

- Spatial resolution

Point clouds: ~80-100 pts/m^2, ~20-30 ground pts/m^2
DTM: 30 cm

- Accuracy and errors:

Laser scanner (Riegl MiniVux1-UAV)

  - Accuracy: 15 mm
  - Precision: 10 mm
  - Angle measurement resolution: 0.001°

GNSS-IMU RMS Error (Applanix APX-20 UAV)

  - Position: 0.02-0.05 m
  - Velocity: 0.010 m/s
  - Roll & Pitch: 0.015°
  - True Heading: 0.035°

- Data formats

Lidar pointclouds: .laz tiles
DTMs: .tif rasters

- Data processing methods

Drone trajectories were processed in POSPac UAV. The drone trajectories were imported into RiProcess, where turns were removed using the RXP cutter tool. A field of view filter was used to only import and process laser data collected within 45 degrees of nadir (90°). Control objects (points) were added, and the flight lines were aligned using RiPrecision. Once the flight lines were suitably aligned, the data could be exported. The exported point cloud was classified and rasterized using LAStools. More details for the processing methods can be found in Salomon et al., (2024): *Seismica*

Misc Notes

This research occurred on the traditional territory of the Tr'ondëk Hwëch'in. We thank Jordan Ross and Hussain Malik of the Tr'ondëk Hwëch'in Government for their support of our fieldwork. This work was permitted under Yukon Scientists and Explorers Act Licence #23-81S&E.

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References:

Finley, T., Nissen, E., Cassidy, J., Salomon, G., Leonard, L., Froese, D., Exceptionally long intervals between large earthquakes on the low slip-rate Tintina fault, Yukon: *Submitted Manuscript.*

Salomon, G., Finley, T., Nissen, E., Stephen, R., and Menounos, B., 2024, Mapping fault geomorphology with drone-based lidar: Seismica, v. 3, doi:10.26443/seismica.v3i1.1186.