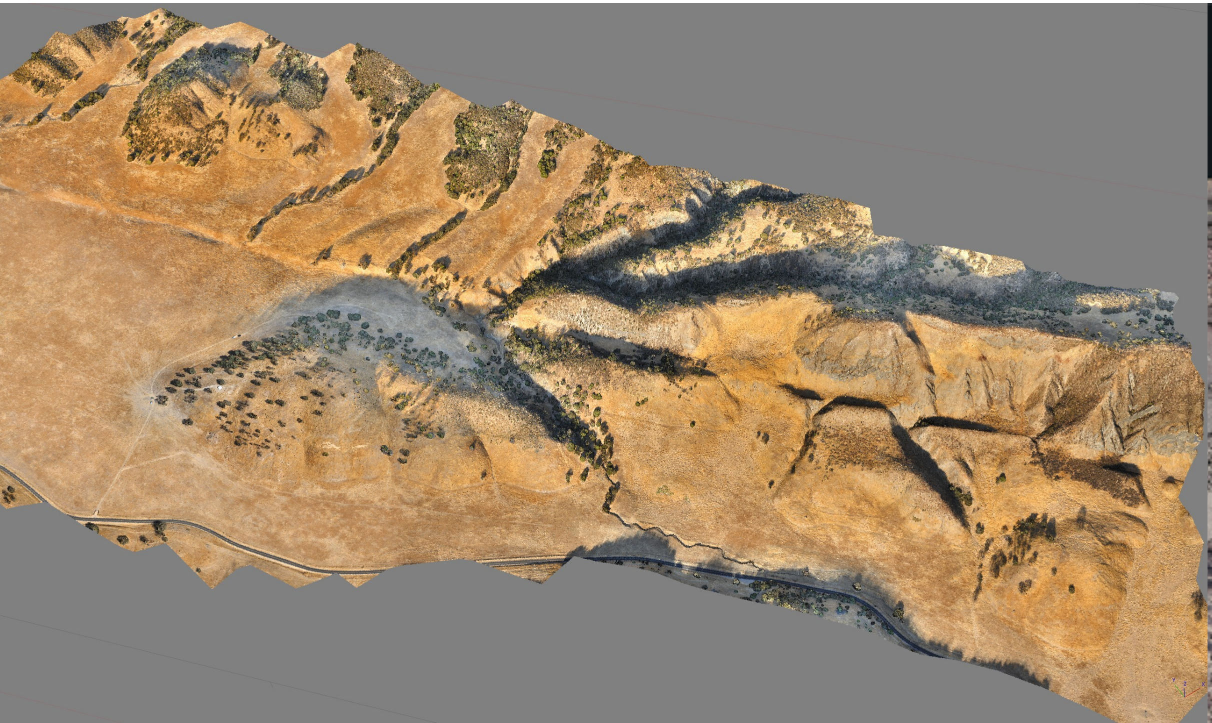
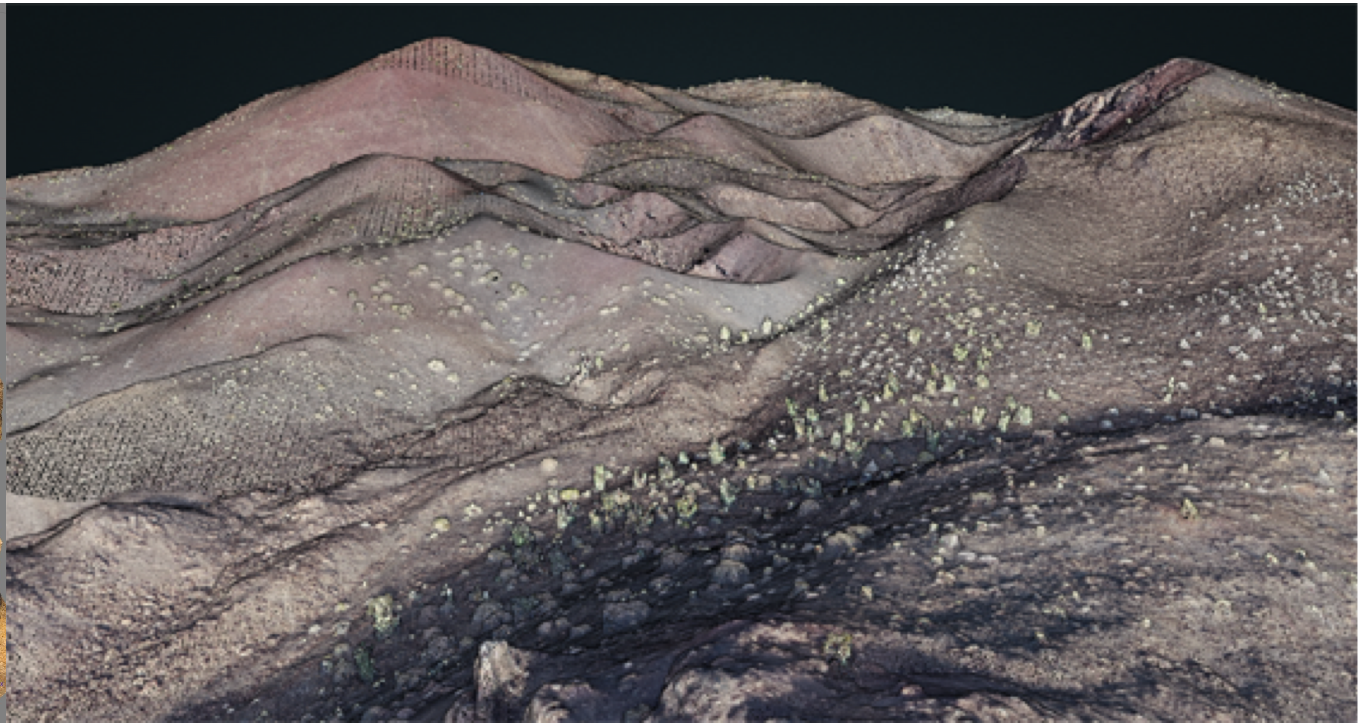
What can I do with my data after it finishes processing?

Chelsea Scott

GSA 2021

October 4, 2021



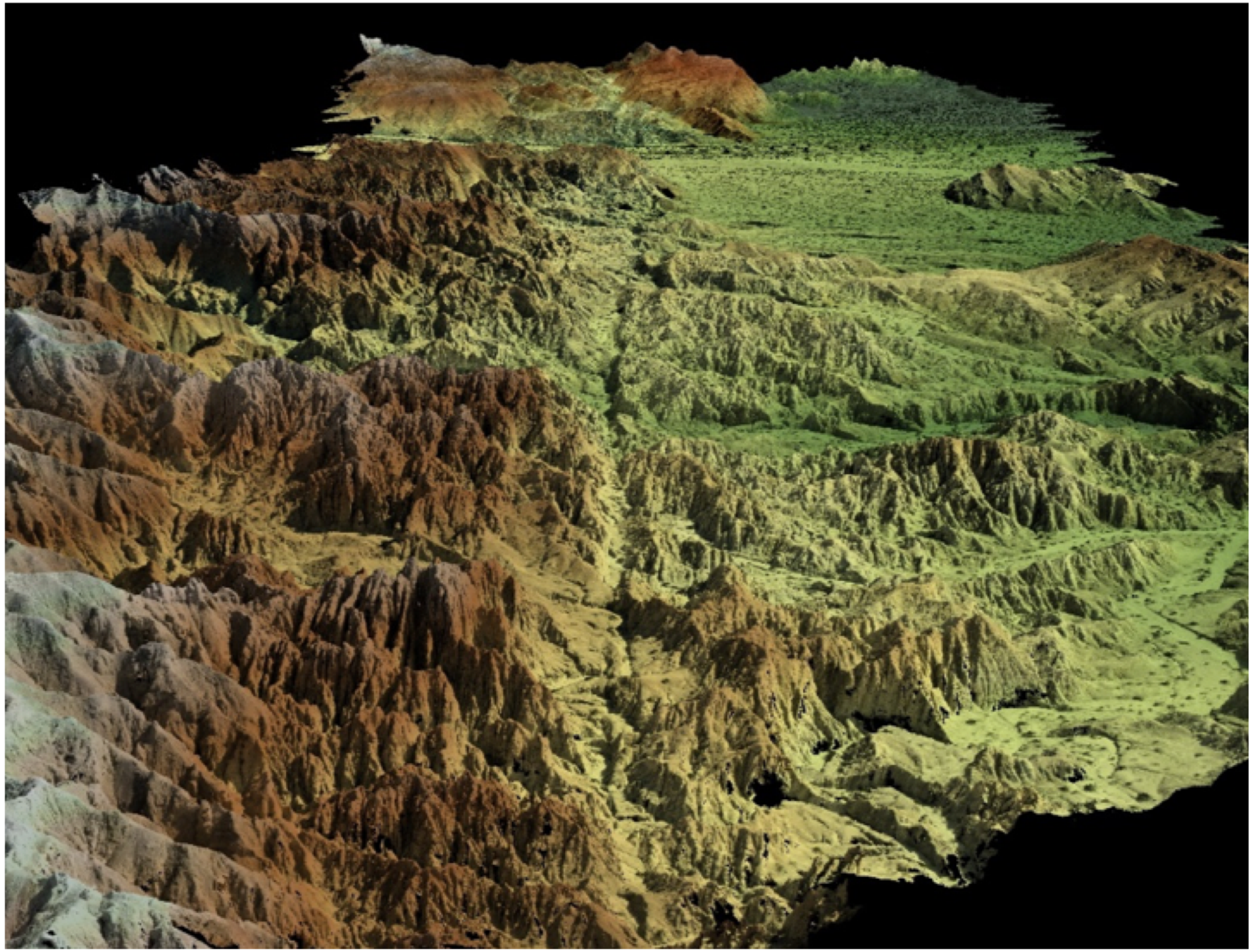


Outline

Cloud Compare & structural geology: Measuring strike and dip near the San Andreas Fault with Cloud Compare

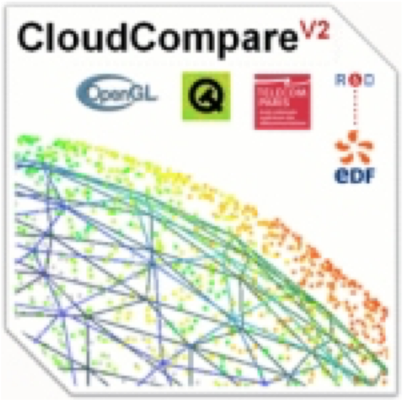
LIME

Authoring datasets



Southern San Andreas Fault: Bunds et al (2021)

Cloud Compare

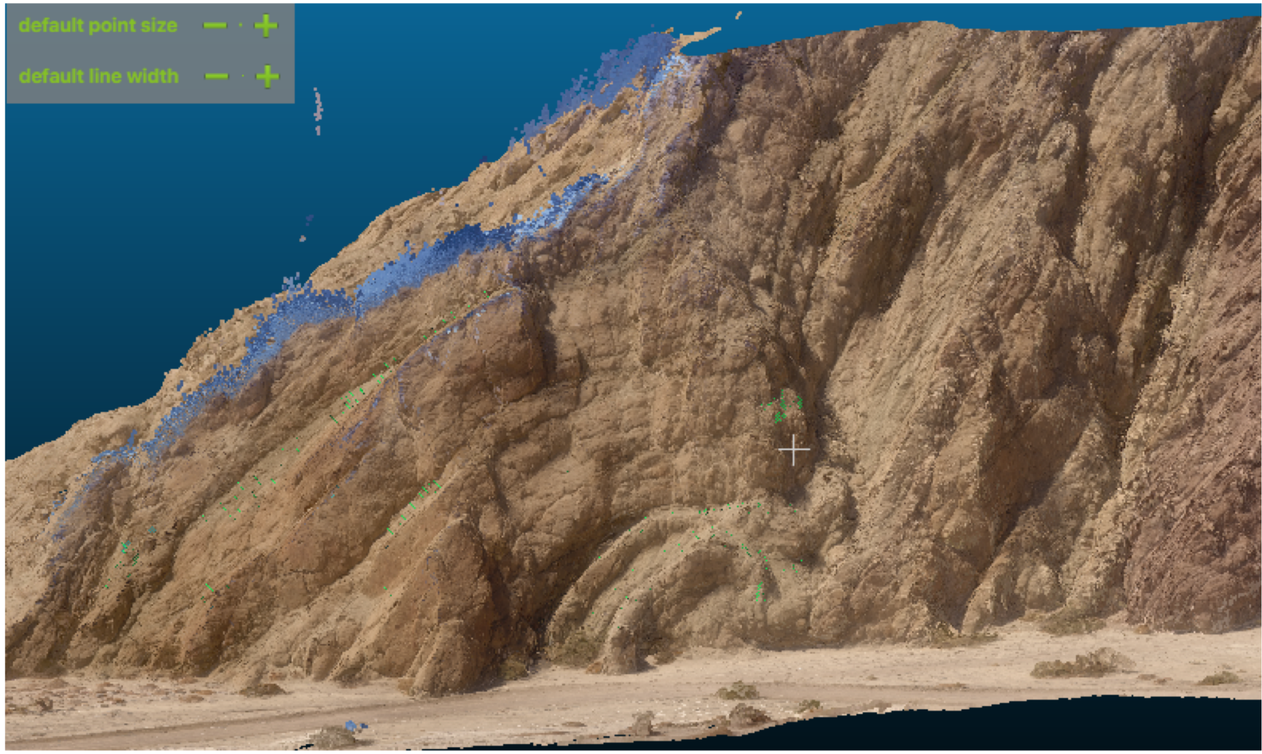


CloudCompare

3D point cloud and mesh processing software
Open Source Project

https://www.danielgm.net/cc/

Painted Canyon



https://doi.org/10.5069/G90G3H94

Painted Canyon Exercise

https://opentopography.org/learn/painted_canyon

Painted Canyon Demo

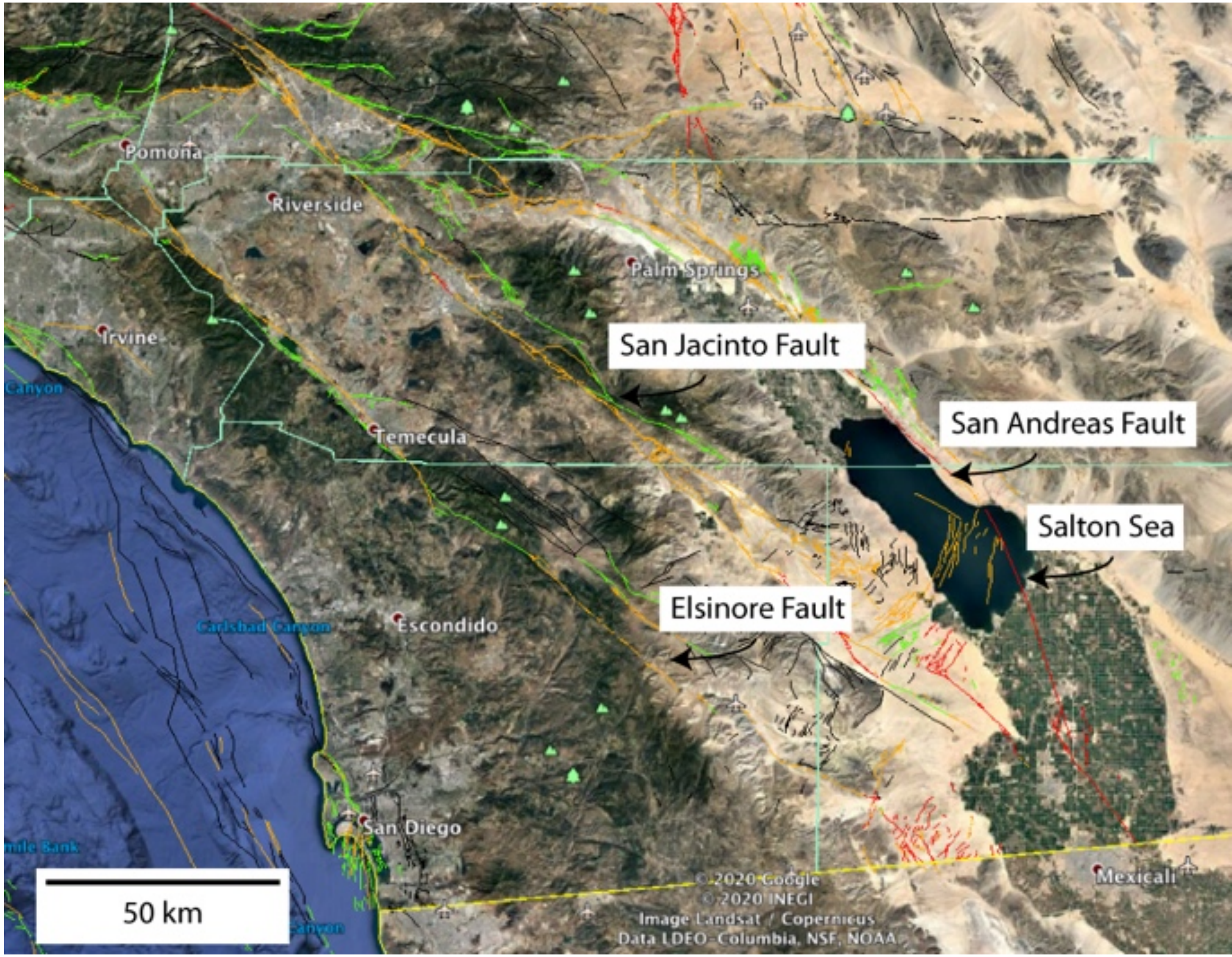
Visualize a point cloud

Change the display

Make strike and dip measurements

Make length measurements

Compile data into Stereonet



Rapid, semi-automatic fracture and contact mapping for point clouds, images and geophysical data

Samuel T. Thiele, Lachlan Grose, Anindita Samsu, Steven Micklethwaite, Stefan A. Vollgger, and Alexander R. Cruden

School of Earth, Atmosphere and Environment, Monash University, Melbourne, 3800, Australia

Correspondence: Samuel T. Thiele (sam.thiele@monash.edu)

Received: 3 August 2017 – Discussion started: 15 August 2017
Revised: 14 November 2017 – Accepted: 16 November 2017 – Published: 21 December 2017

https://doi.org/10.5194/se-8-1241-2017

Demo- at least 10 mins + questions

How to image an outcrop?

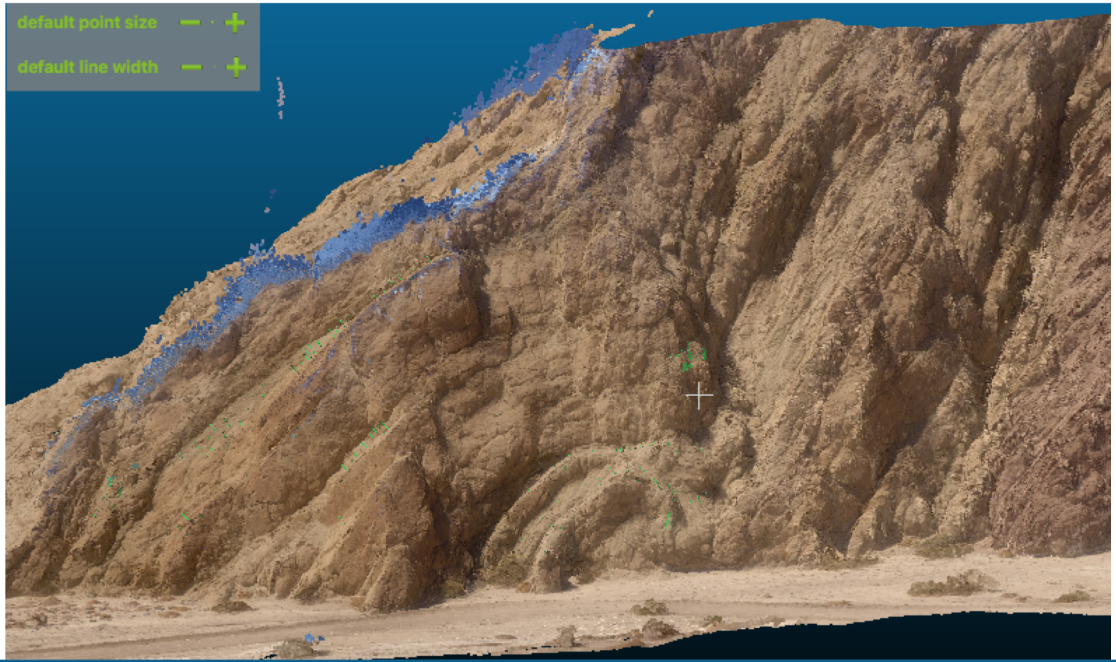
Orient the UAV’s camera to face the outcrop

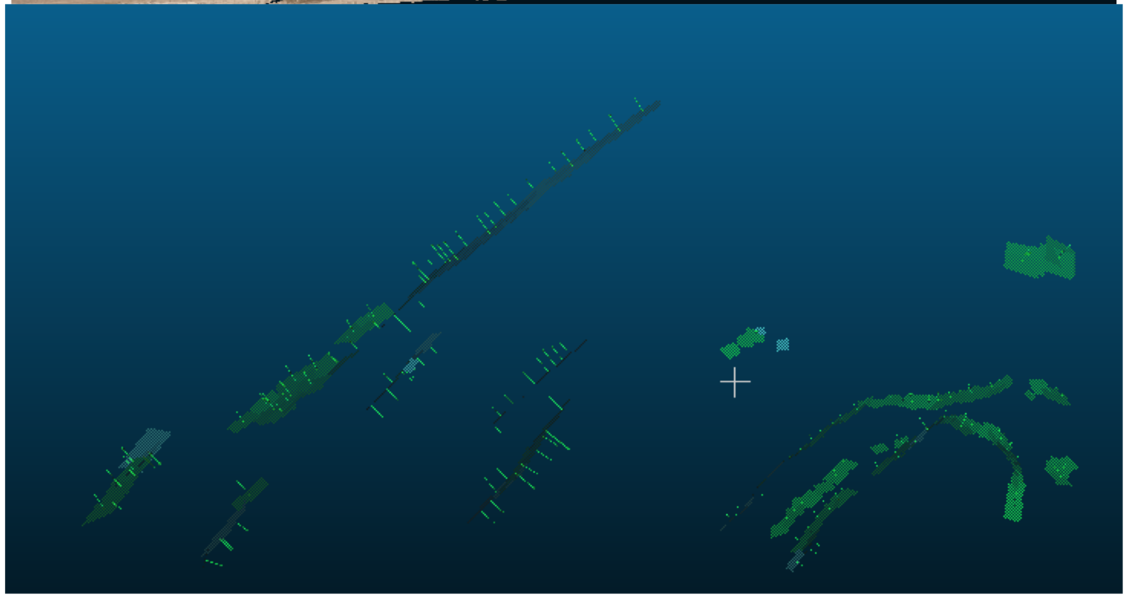
Set automatic photos every several seconds

Carefully and manually fly the UAV up and down the outcrop

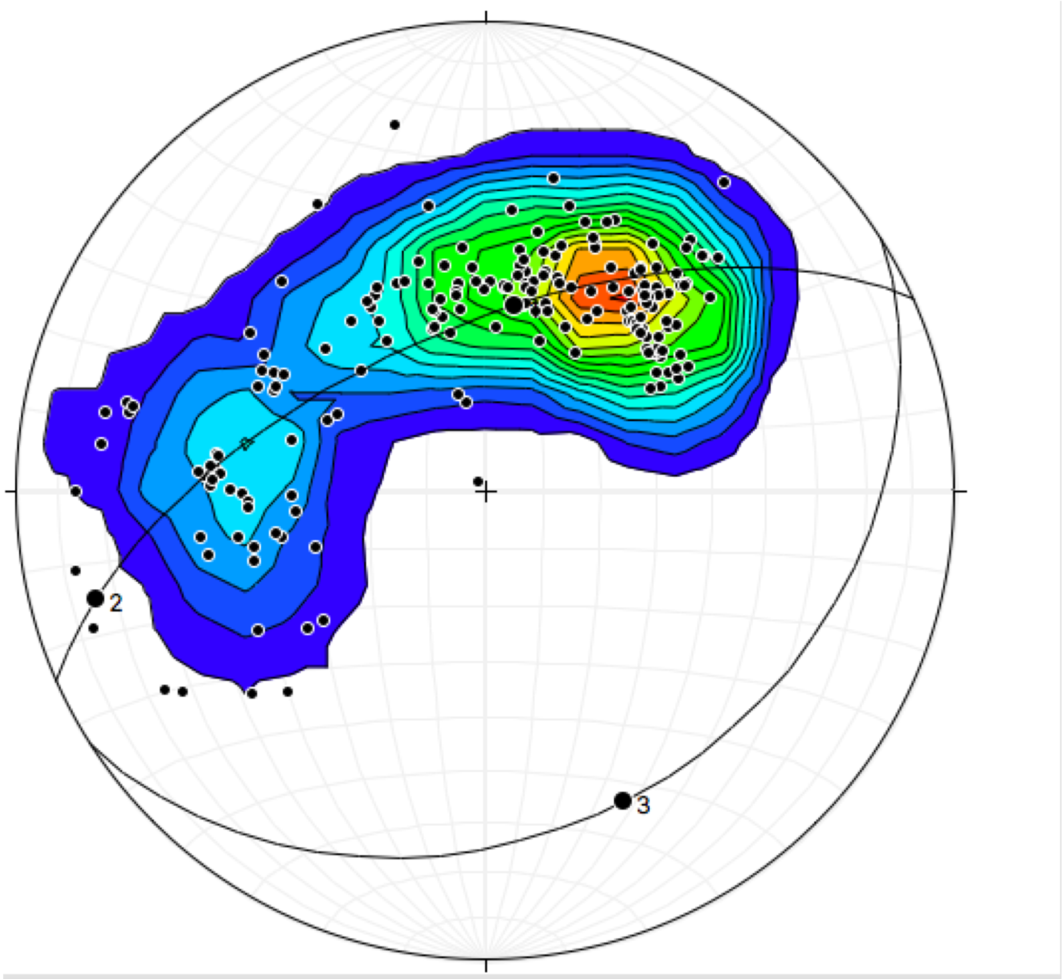
It’s hot in early September in the Imperial Valley!

Think about your surroundings, safety, and FAA & local regulations.





Strike and dip measurements



Stereonet:
https://www.rickallmendinger.net/stereonet

This exercise is available from OpenTopography

OpenTopography
High-Resolution Topography Data and Tools

HOME DATA RESOURCES LEARN ABOUT

A Structural Geology Exercise for Remotely Examining Folds at Painted Canyon Near the San Andreas Fault

By Chelsea Scott and Ramon Arrowsmith

School of Earth and Space Exploration, Arizona State University

We designed an exercise for structural geology classes where students learn about the classical Painted Canyon site (Sylvester and Smith, 1976; Sylvester, 1988) near the Southern San Andreas Fault, California, by analyzing a point cloud of a fold located near the fault. We developed this exercise for a graduate-level structural geology class at Arizona State University and expect that it would also fit well into undergraduate-level classes. Given the recent necessity for remote learning and the associated challenges with taking students to the field, we anticipate that this exercise could serve as an alternative to typical field activities with a structural geology emphasis.

In this exercise, students are given a point cloud of a fold in Painted Canyon. It was produced by the structure from motion (SfM) approach from photographs collected with a small Uncrewed Aerial Vehicle (sUAV) or drone (See this link for more educational material). Students use the Compass tool in CloudCompare to measure fold limb orientation. They plot their measurements in Stereonet (or could do so by hand), solve for the axial plane orientation, and calculate the average strain rate recorded in the folded unit Students are asked to then relate their measurements to the San Andreas Fault. Is the orientation consistent with the expected strain field given a right-lateral fault zone?

https://opentopography.org/learn/painted_canyon

Email Chelsea Scott cpscott1@asu.edu for the answers (instructors only)

Buckley, S.J., Ringdal, K., Naumann, N., Dolva, B., Kurz, T.H., Howell, J.A., and Dewez, T.J.B., 2019, LIME: Software for 3-D visualization, interpretation, and communication of virtual geosci- ence models: Geosphere, v. 15, https://doi.org/10.1130/GES02002.1.

Software Contribution

GEOSPHERE

GEOSPHERE, v. 15, no. 1

https://doi.org/10.1130/GES02002.1

9 figures

CORRESPONDENCE:
simon.buckley@norceresearch.no

CITATION: Buckley, S.J., Ringdal, K., Naumann, N., Dolva, B., Kurz, T.H., Howell, J.A., and Dewez, T.J.B., 2019, LIME: Software for 3-D visualization, interpretation, and communication of virtual geoscience models: Geosphere, v. 15, no. 1, https://doi.org/10.1130/GES02002.1.

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LIME: Software for 3-D visualization, interpretation, and communication of virtual geoscience models

Simon J. Buckley[1,2], Kari Ringdal[1], Nicole Naumann[1], Benjamin Dolva[1], Tobias H. Kurz[1], John A. Howell[3], and Thomas J.B. Dewez[4]

[1]NORCE Norwegian Research Centre AS, P.O. Box 22, N-5838 Bergen, Norway
[2]Department of Earth Science, University of Bergen, P.O. Box 7803, N-5020 Bergen, Norway
[3]Department of Geology and Petroleum Geology, University of Aberdeen, Aberdeen AB24 3UE, UK
[4]BRGM–French Geological Survey, 45060 Orléans, France

ABSTRACT

The use of three-dimensional (3-D), photo-textured representations of topography from laser scanning and photogrammetry is becoming increasingly common across the geosciences. This rapid adoption is driven by recent innovations in acquisition hardware, software automation, and sensor platforms, including unmanned aerial vehicles. In addition, fusion of surface geometry with imaging sensors, such as multispectral, hyperspectral, thermal, and ground-based radar, and geophysical methods creates complex and visual data sets that provide a fundamental spatial framework to address open geoscience research questions.

Despite the current ease of acquiring and processing 3-D photo-textured models, the accessibility of tools for analyzing and presenting data remains problematic, characterized by steep learning curves and custom solutions for individual geoscience applications. Interpretation and measurement is essential for quantitative analysis of 3-D data sets, and qualitative methods are valuable for presentation purposes, for planning, and in education. This contribution presents LIME, a lightweight and high-performance 3-D software for interpreting and co-visualizing 3-D models and related image data. The software allows measurement and interpretation via digitizing in the 3-D scene. In addition, it features novel data integration and visualization of 3-D topography with image sources such as logs and interpretation panels, supplementary wavelength imagery, geophysical data sets, and georeferenced maps and images. High-quality visual output can be generated for dissemination to aid researchers with communication of their results. The motivation and an overview of the software are described, illustrated by example usage scenarios from outcrop geology, multi-sensor data fusion, and geophysical-geospatial data integration.

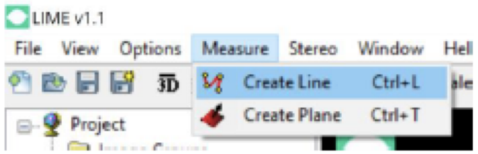
INTRODUCTION

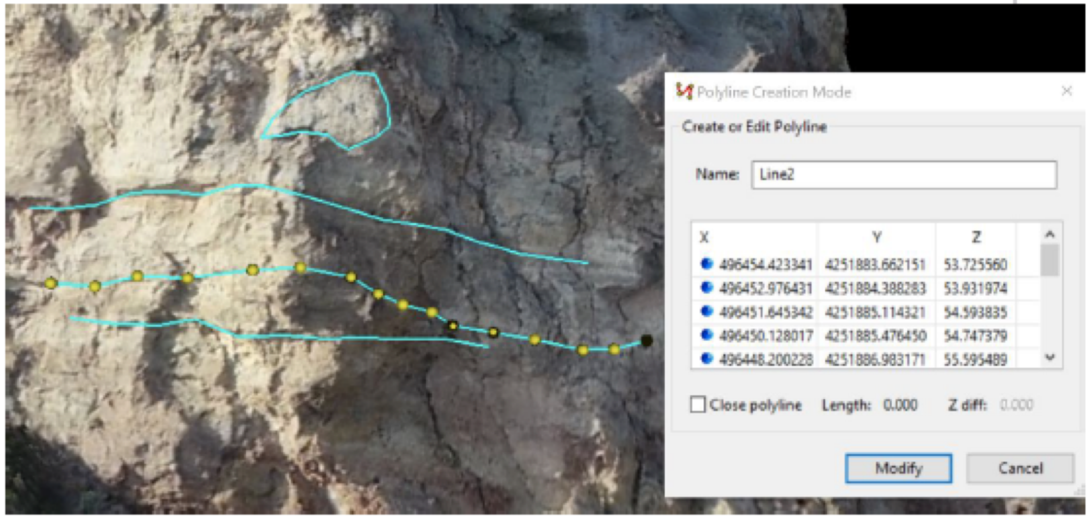
The use of digital spatial data is becoming commonplace in many areas of the geosciences (for example in geology, geomorphology, cryospheric science, volcanology, natural hazards, hydrology, energy, infrastructure, and mining). Laser scanning (lidar), global navigation satellite systems (GNSS), digital photogrammetry (also referred to as structure from motion [SfM]), and imaging remote sensing have all evolved heavily over the last two decades, and are distinguished by unprecedented resolution, precision, and ease of use. Computing hardware has developed to facilitate field-based acquisition (Weng et al., 2012; Kehl et al., 2017), and more analysis tools are available in geographical information systems (GIS). The evolving state of the art can be followed through the scientific literature, from early adoption to the status quo. This is exemplified by rapid adoption across the many arms of the geoscience subdisciplines (see, e.g., McCaffrey et al. [2005], Pringle et al. [2006], Buckley et al. [2008a], Kääb [2008], Pavlis et al. [2010], Jaboyedoff et al. [2012], Hodgetts [2013], Bemis et al. [2014], Eitel et al. [2016], Eltner et al. [2016], Kehl et al. [2017], and Squelch [2017] as a small subset of papers providing snapshots of developments through time).

The reinvention of photogrammetry—a technique that has advanced in line with photographic innovations—has recently intensified the adoption of three-dimensional (3-D) spatial data by geoscientists. This has been driven by the ubiquity of digital cameras and major increases in automation arising from scientific outputs from the computer vision discipline (e.g., interest operators, feature point matching, and dense point cloud extraction; Granshaw and Fraser, 2015), which have been implemented in easy-to-use software packages. In addition, new dynamic sensor platforms such as unmanned aerial vehicles (UAVs) and mobile mapping systems allow 3-D acquisition in a wide range of configurations, and extended-spectral-range imaging sensors (multispectral and hyperspectral, thermal, radar; Eitel et al., 2016) provide new possibilities for complementing purely geometric approaches (Buckley et al., 2013). Finally, societal policy shifts have moved toward making geospatial data freely available to the public through public- or private-sector initiatives (Krishnan et al., 2011; U.S. Geological Survey, 2017; Norwegian Mapping Authority, 2017).

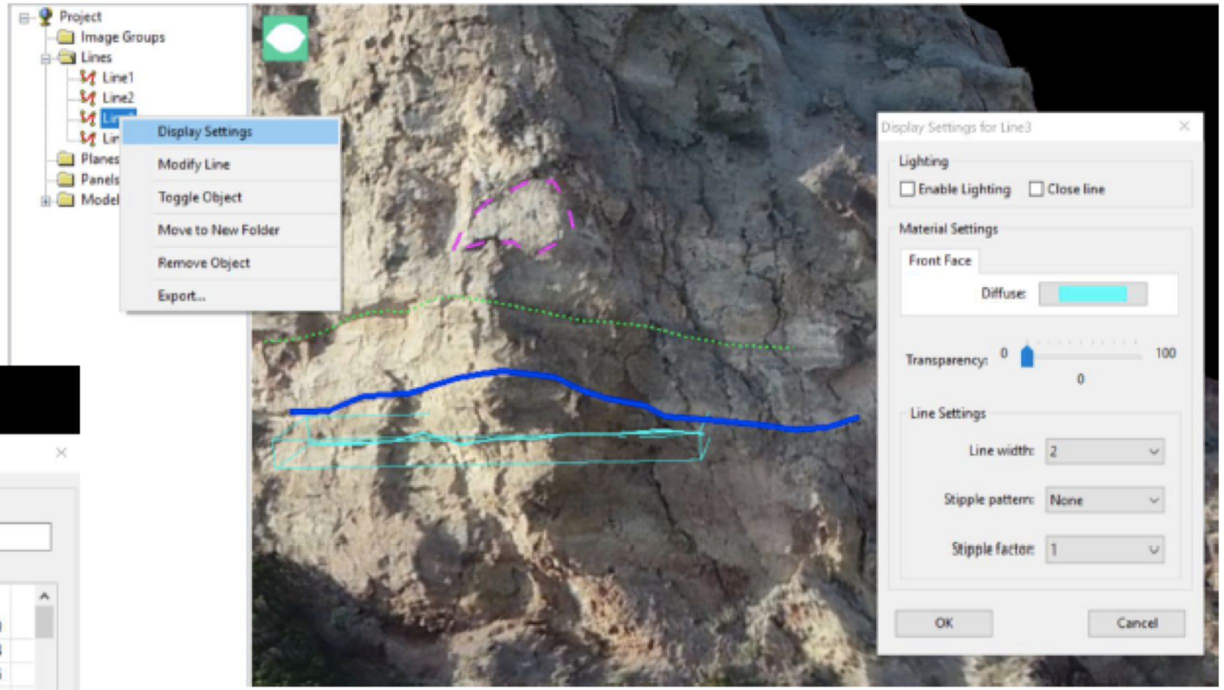
These developments have facilitated workflows for obtaining 3-D digital representations of surface topography across the range of scales (i.e., hand sample to regional elevation models). Consequently, geoscientists are

Create a line





Hold Shift and click out the desired polyline. Let go of shift to move model. Click create to move to next polyline. To create a polygon select close polyline



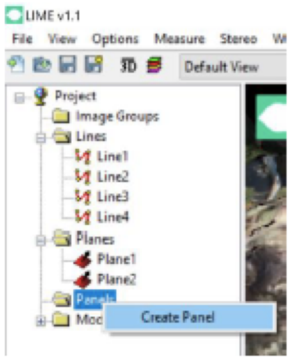
Right click on line in workspace to change display settings or modify the line.

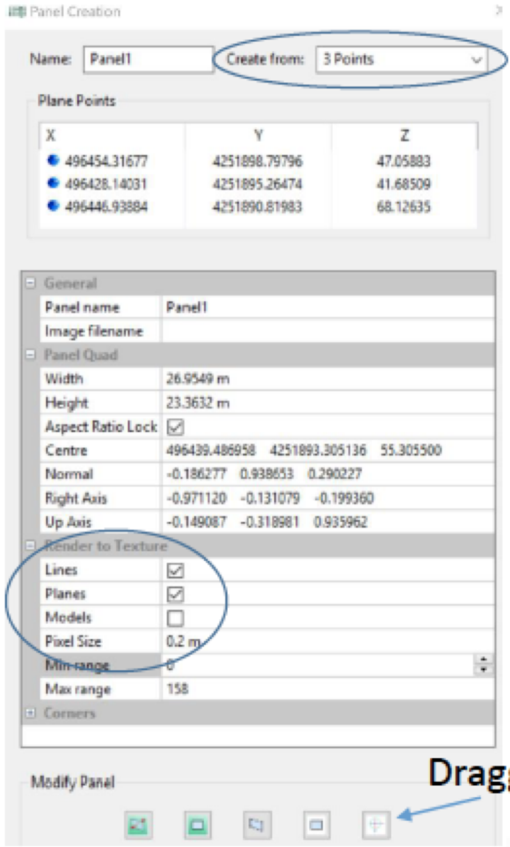
Can also create a plane

Explore linework in GIS file types

Create a Panel

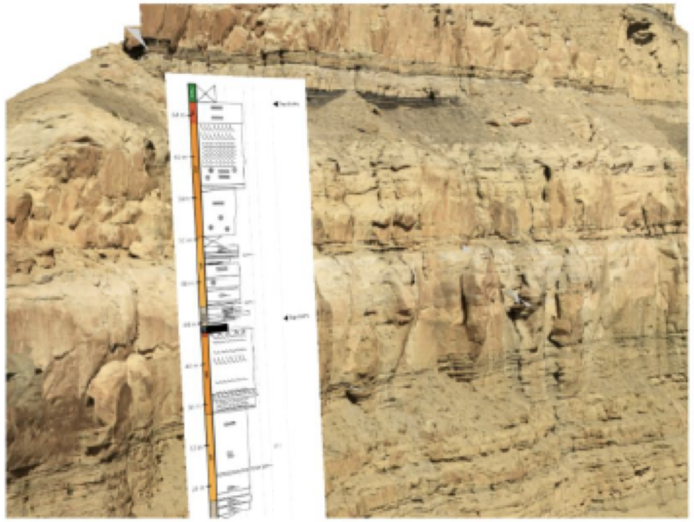
Project lines and planes onto a panel or import and image onto a panel



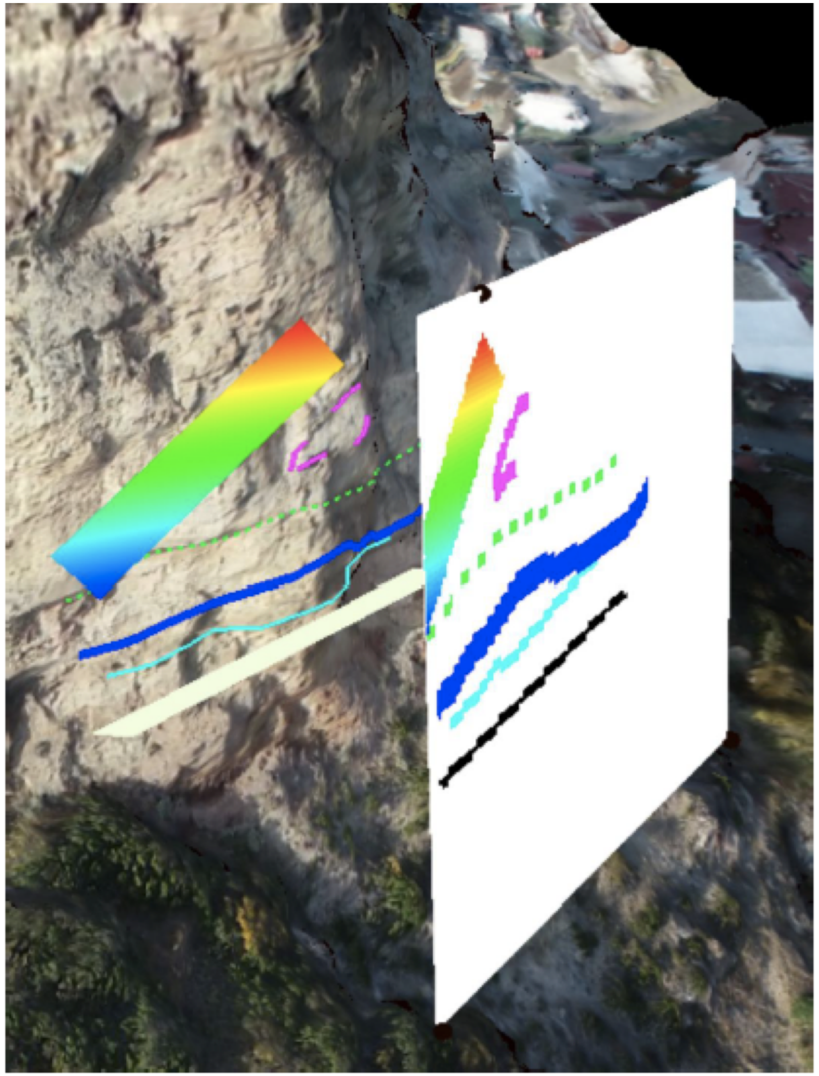


Draggers

Choose the features you want projected and adjust pixel size for better visibility. Moving the panel is a tricky so use Draggers.

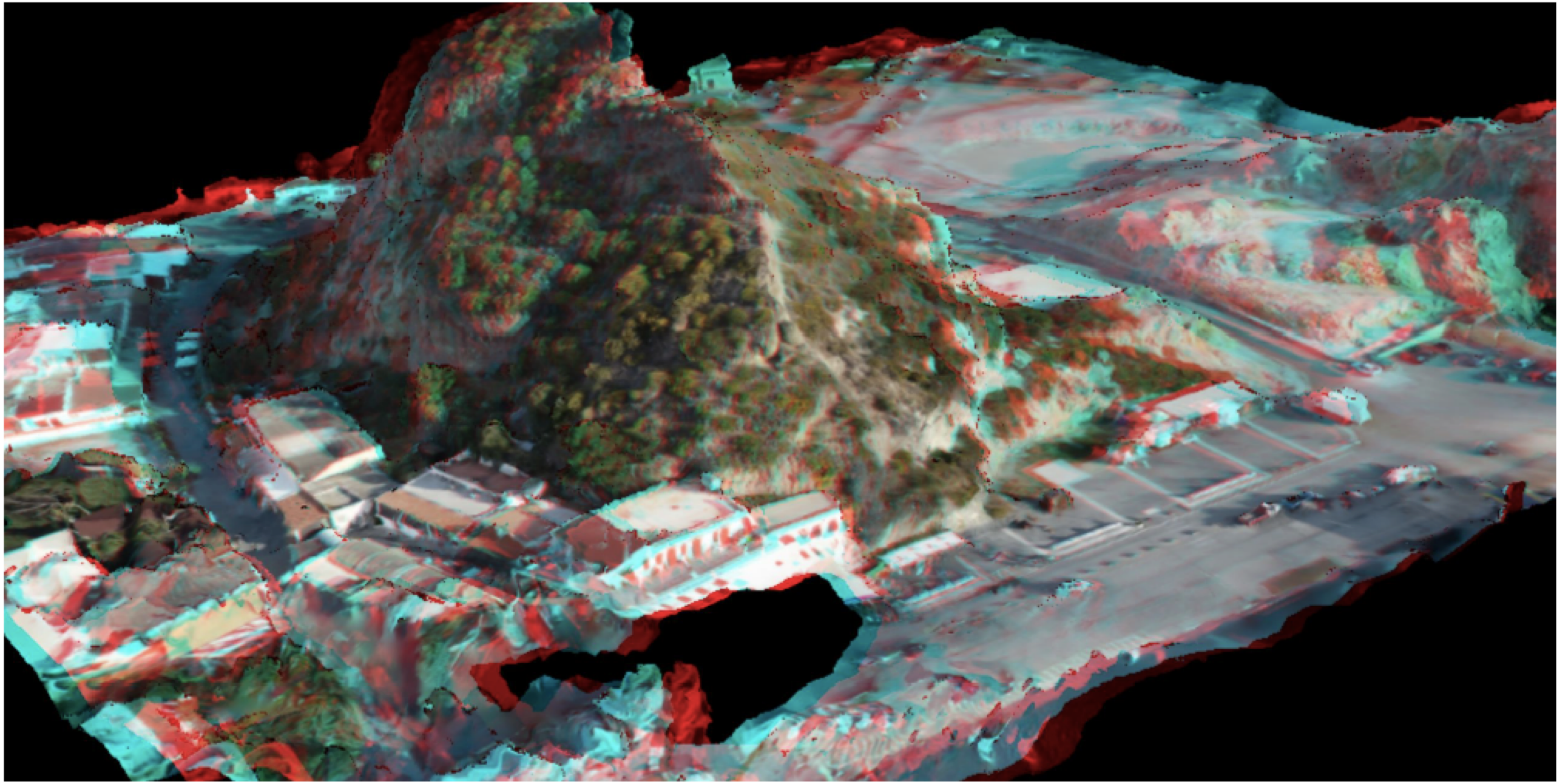


Sedimentary log placed relative to outcrop model (courtesy of Dr Christian Haug Eide, University of Bergen).



Project your lines and planes from Faraglione

Stereo option



Publishing your data:

Why?

- Required for publication with a journal
- Dataset reuse

OpenTopography's Community Dataspace

OpenTopography
High-Resolution Topography Data and Tools

Contribute Data

OT provides suggested metadata
Reviewed by OT team
Receive DOI

Sketchfab