Drones4Discovery: High resolution field data using drones & digital pipelines

Steven Micklethwaite
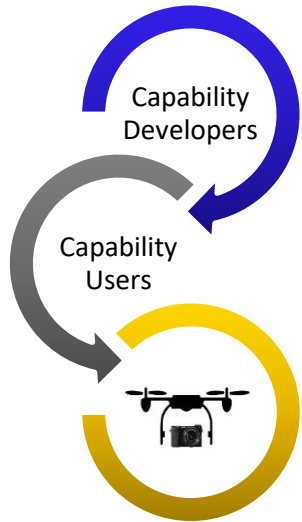
MONASH University

GROUP OF EIGHT AUSTRALIA

DRONE DISCOVERY PLATFORM

Visualisation

"To sense our world in greater detail, with greater quality over greater areas, and to develop the technology and data analytics that can do so for the benefit of Australian research, industry and education."

Data Analytics

dolerite

tonalite

gabbro

- Advanced remote sensing & sampling technologies + HPC/Cloud + analytics

- For Research-Education-Industry Impact

- Driving interdisciplinary developments (Science-Engineering-IT-Arts)

- Regulatory oversight with CASA, including pilots (protecting research)
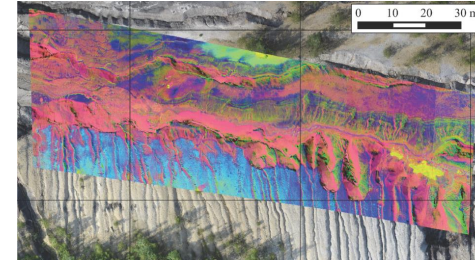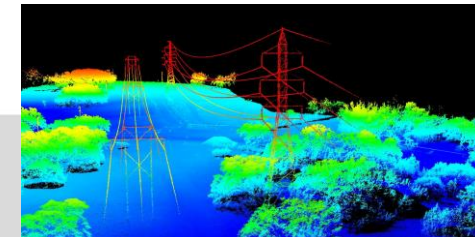
- Leveraging MTRPs

Capability Developers

Capability Users

Hyperspec

0 10 20 30 m

LiDAR

$1.3M ARC LIEF
&
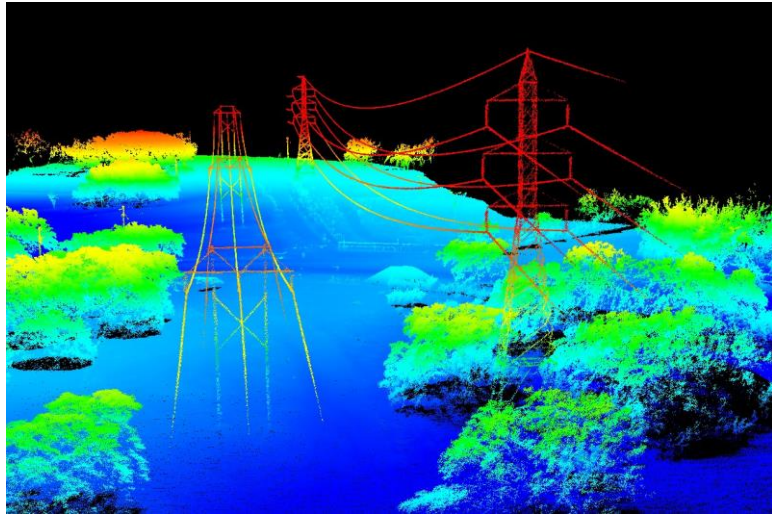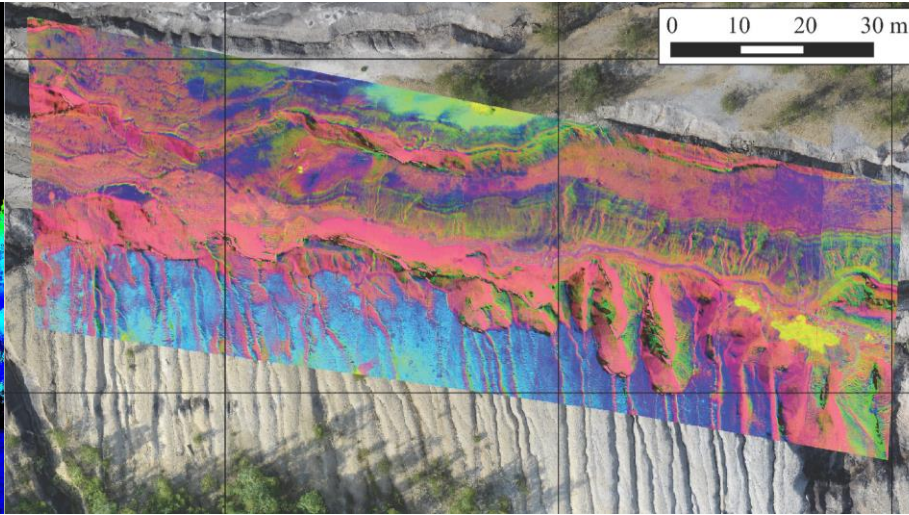$5.6M Monash foundation Investment
&
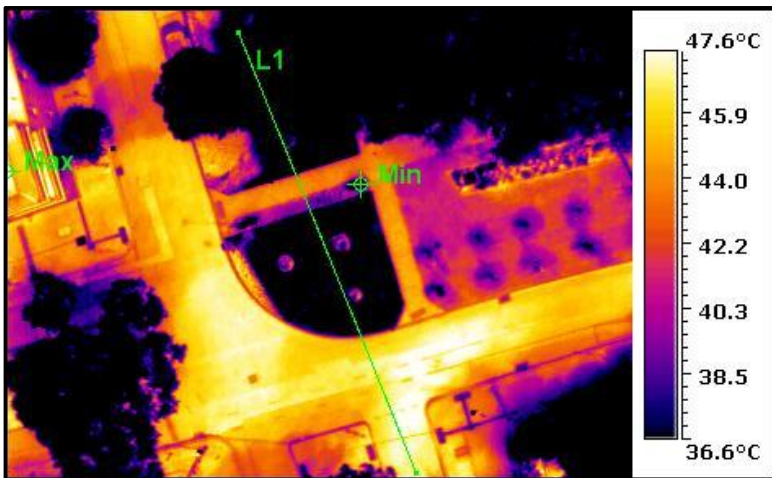AuScope (under development)

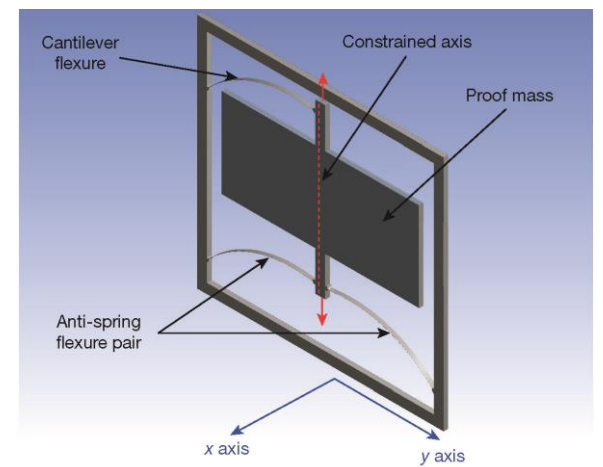# Flagship

Workhorse

LiDAR

Hyperspec (VNIR-SWIR)

UAV-mag

6.1 X 10⁴ nT

5.8 X 10⁴ nT

0 m   400 m
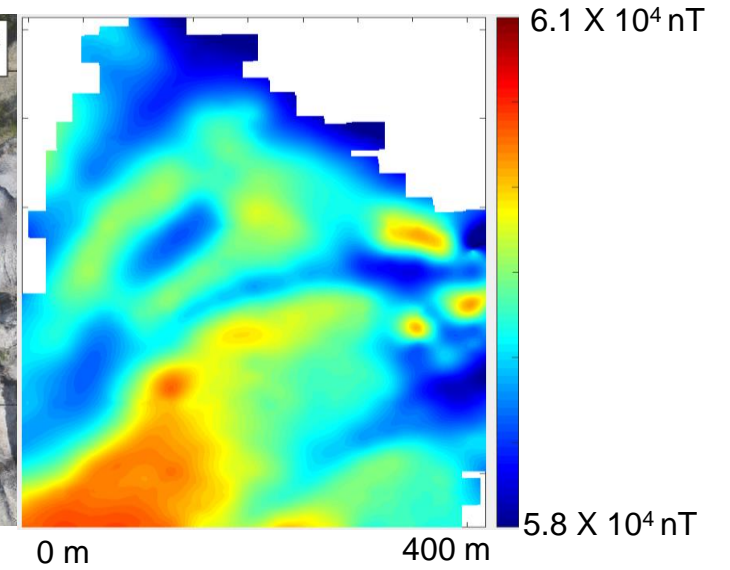
Thermal

Visualisation

MEMS gravimetry

DATA ANALYTICS – CNN EXAMPLE

Original image (4000 x 6000 pixels)

Ground truth labelled image
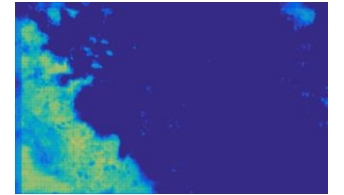Manual digitisation: 51 mins
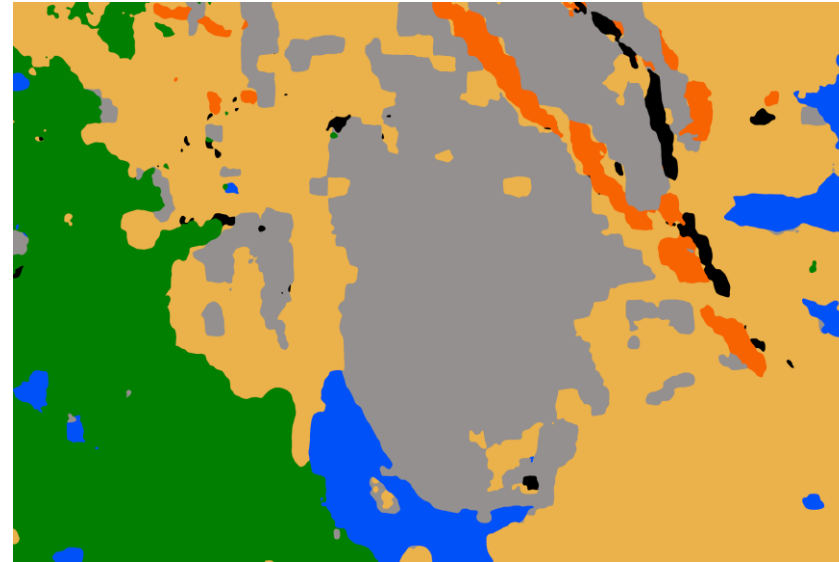
HSV input, random sampling (500), scale variation
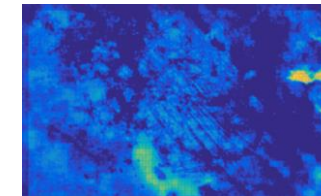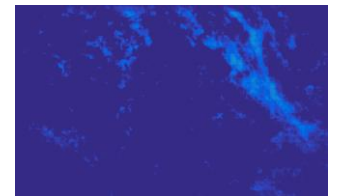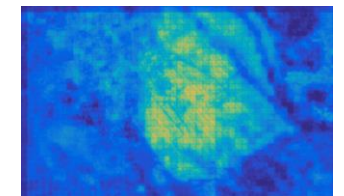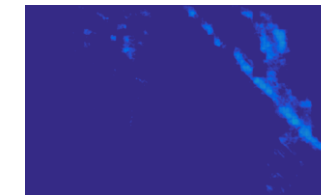Time taken: 82.34 seconds
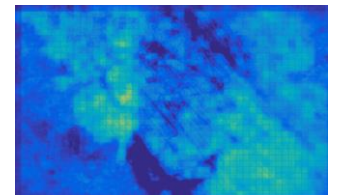Pixel accuracy: 75.05 %

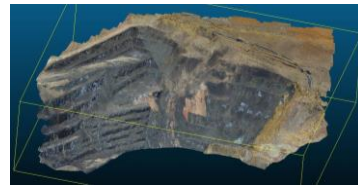Background

Vegetation

Water

Dolerite
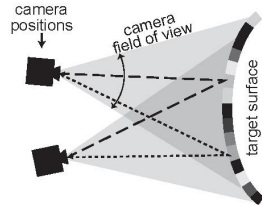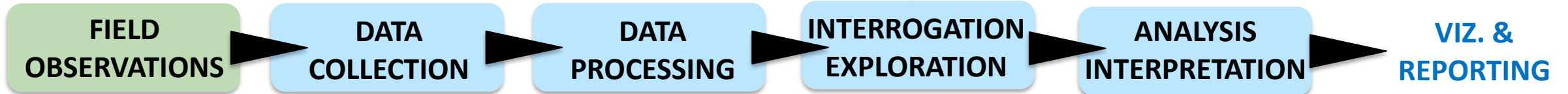

Aplite

Tonalite

Dacite

Gabbro
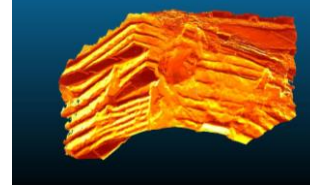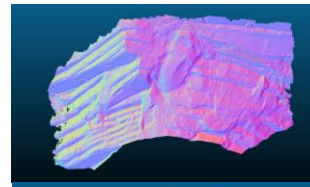
DATA FLUENCY: Photogrammetry example

EXTENDING PHASE

RAW DATA PHASE ...   FIELD BASE MAP   **... INFORMATION PHASE**

FIELD OBSERVATIONS → **DATA COLLECTION** → **DATA PROCESSING** → **INTERROGATION EXPLORATION** → **ANALYSIS INTERPRETATION** → **VIZ. & REPORTING**

camera positions

camera field of view

target surface

e.g.
3D point cloud
Orthophoto
DEM

e.g.
Filters
Scalar products
Some ML/DL

Stereogram   dip direction: 0°
270°   90°
180°

Bemis, Micklethwaite et al., JSG 2014
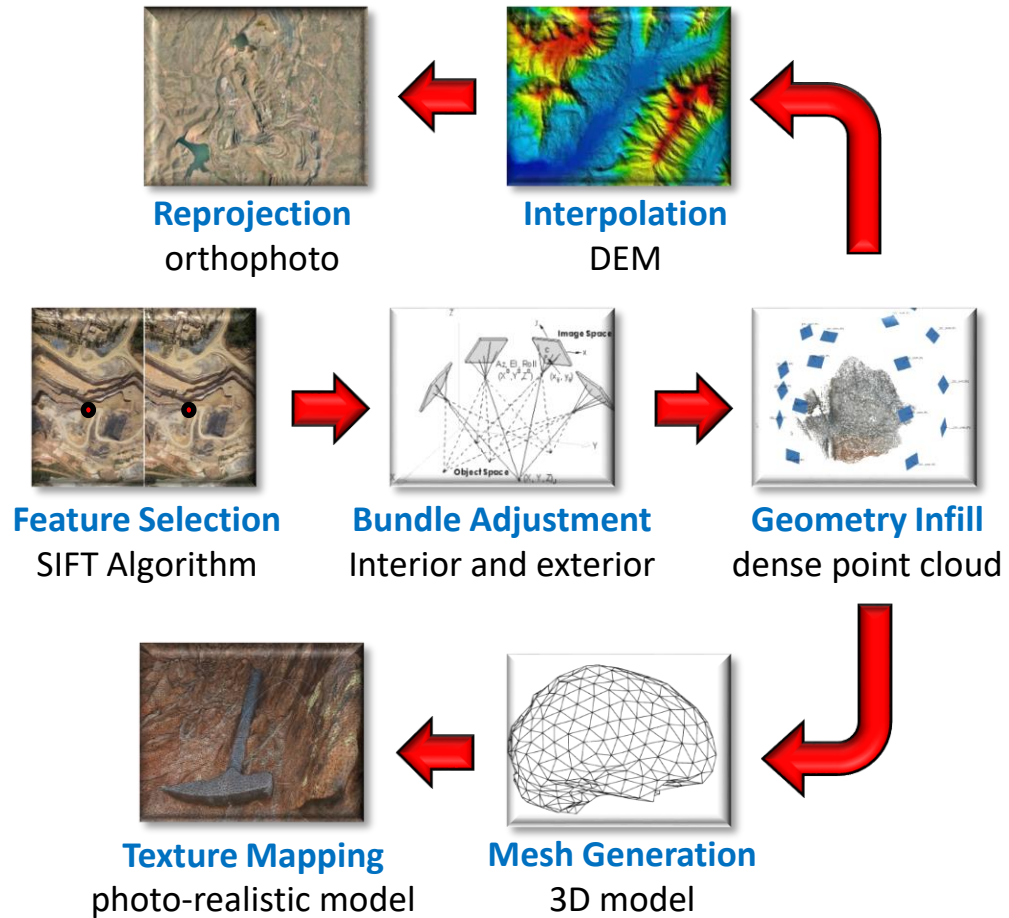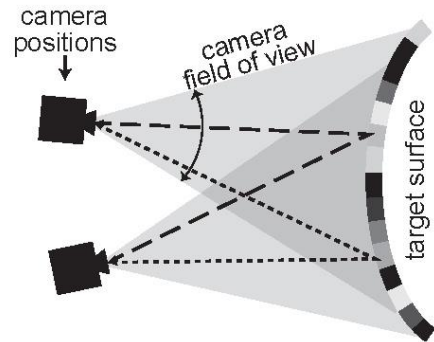
... TIME (opportunity/financial cost)
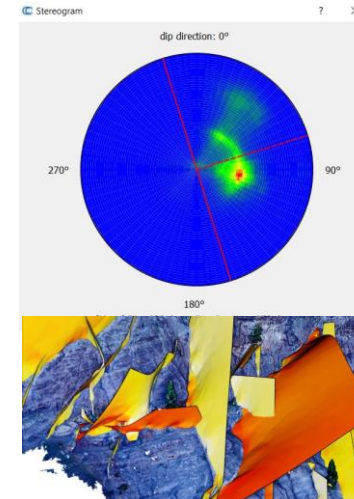
EXAMPLE LOCATION

Century Mine, Queensland

DATA PROCESSING: Photogrammetry example

Photogrammetry (SfM-MVS);

Metashape/Photoscan, Pix4D etc

Bemis, Micklethwaite et al., JSG 2014

Courtesy M. Roach (UTAS)

Reprojection
orthophoto

Interpolation
DEM

Feature Selection
SIFT Algorithm

Bundle Adjustment
Interior and exterior

Geometry Infill
dense point cloud

Texture Mapping
photo-realistic model

Mesh Generation
3D model

INTERROGATION & EXPLORATION

METHOD DEVELOPMENT

a. input data

Point Cloud

Structure trace

Raster

Thiele et al., Solid Earth, 2017
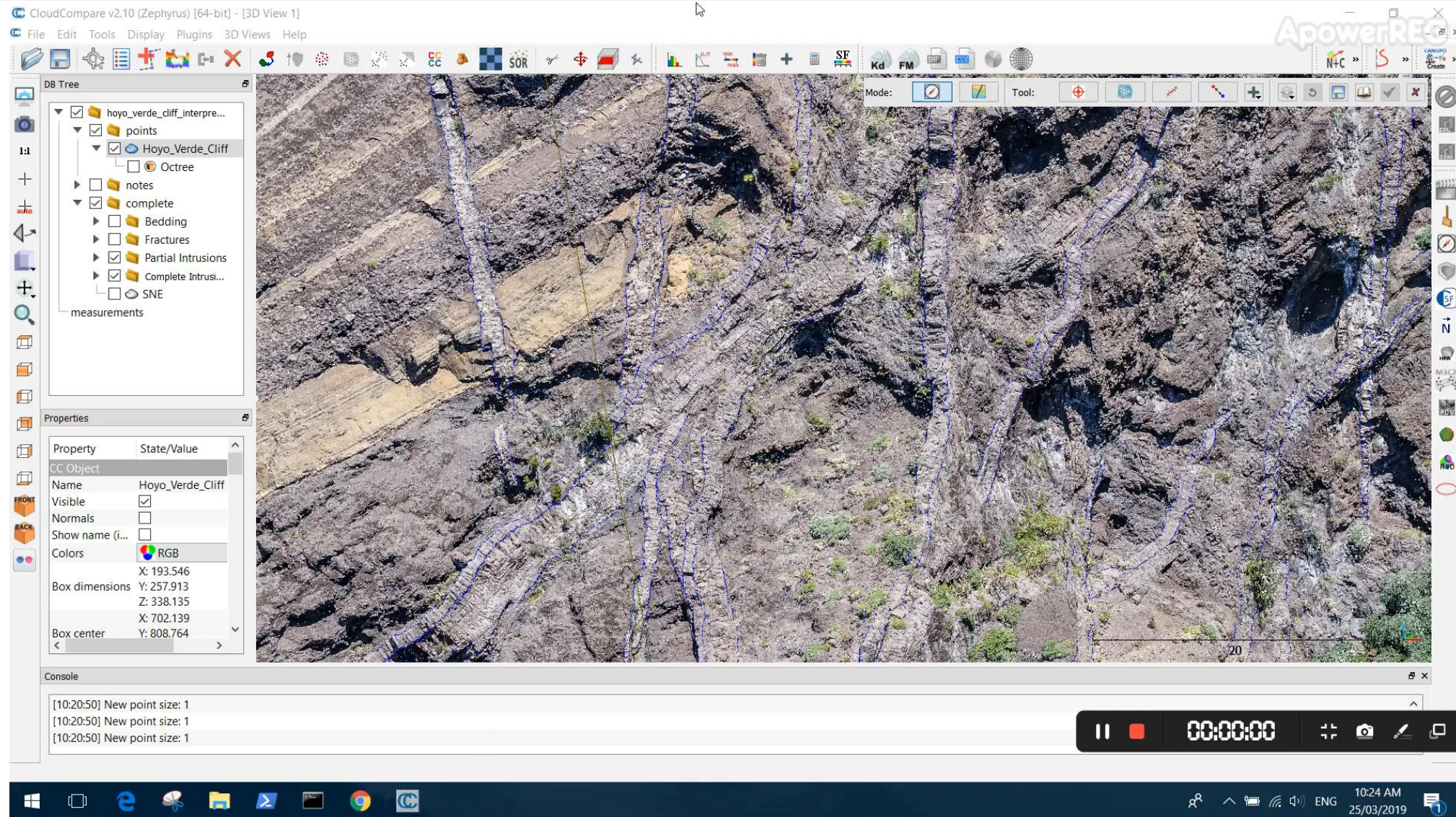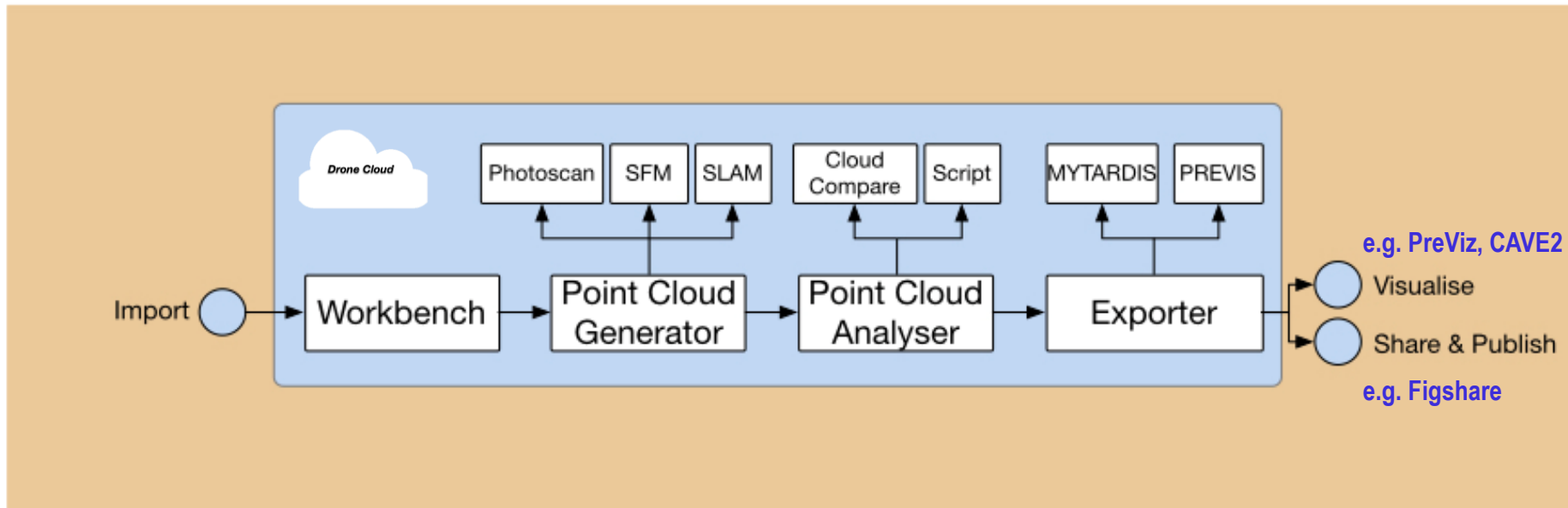
Rapid fault, fracture, lithology contact mapping

- Least-cost path solvers.

- Geologist remains involved in interpretation.

- Future – CNN or other automated

ANALYSIS & INTERPRETATION

15 kilometres of dyke margin mapped @ 5-10 cm spatial resolution (fidelity)
50,000 orientation and thickness measurements

CLOUD COMPUTE: drones to information rapidly

- Extend Workbench Application

- Pluggable Base Pipeline

- User Extendable

  - Define Pipelines & Analysis Scripts

- Process Scans With Multiple Pipelines

- New Point Cloud Generators

  - SFM

  - SLAM

- Add Custom Script Option For Analysis

- Integrate MYTARDIS

CONCLUSIONS

& QUESTIONS