CAPTURE AND GEOLOGICAL DATA EXTRACTION: TOOLS FOR A BETTER ANALYSIS AND DIGITAL MODELLING

UNIVERSITAT DE BARCELONA

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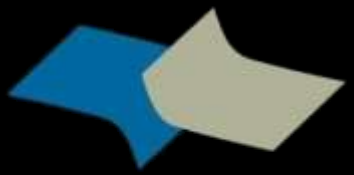

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REPSOL

Digital Workflow

Field Work

Interpretation

Analysis

Outcrop

Digital Capture

Remote Sensing

Lidar

Photogrammetry

Million coordinates XYZ

Reflectivity

Texture color

Data Extraction

Specific Software

Semi-automated Supervised method

Surfaces

Digitalization from 2D to 3D

Lineations

Structure

Rock slope instability

DFN Digital Fracture Network

Specific Modules

Petrel, Move, Fracaflow

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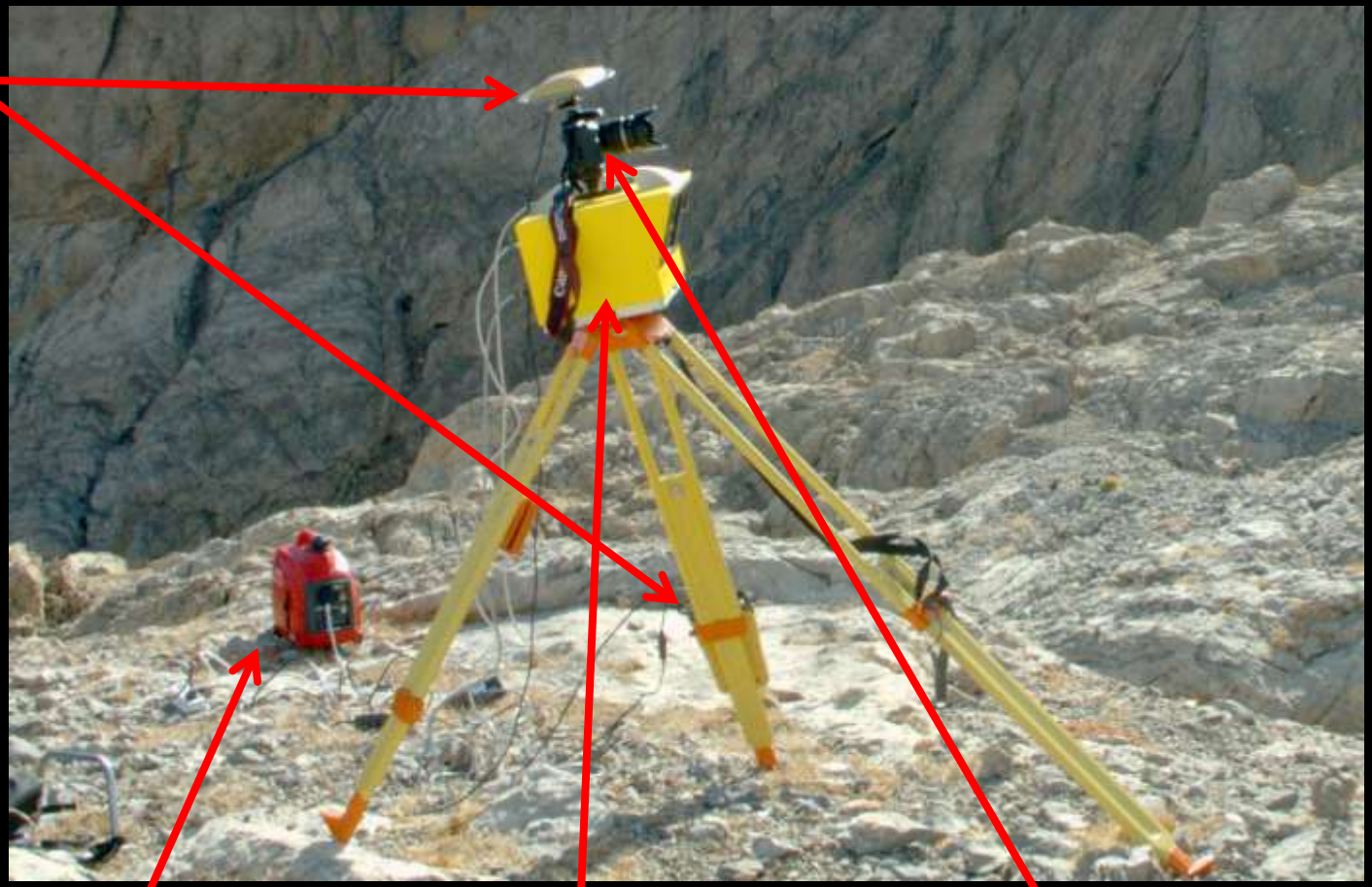
Capture Digital Outcrops

Lidar Equipment

Antenna and DGPS receiver



Electric generator

Laser scanner

Digital camera calibrated

Lidar Processing

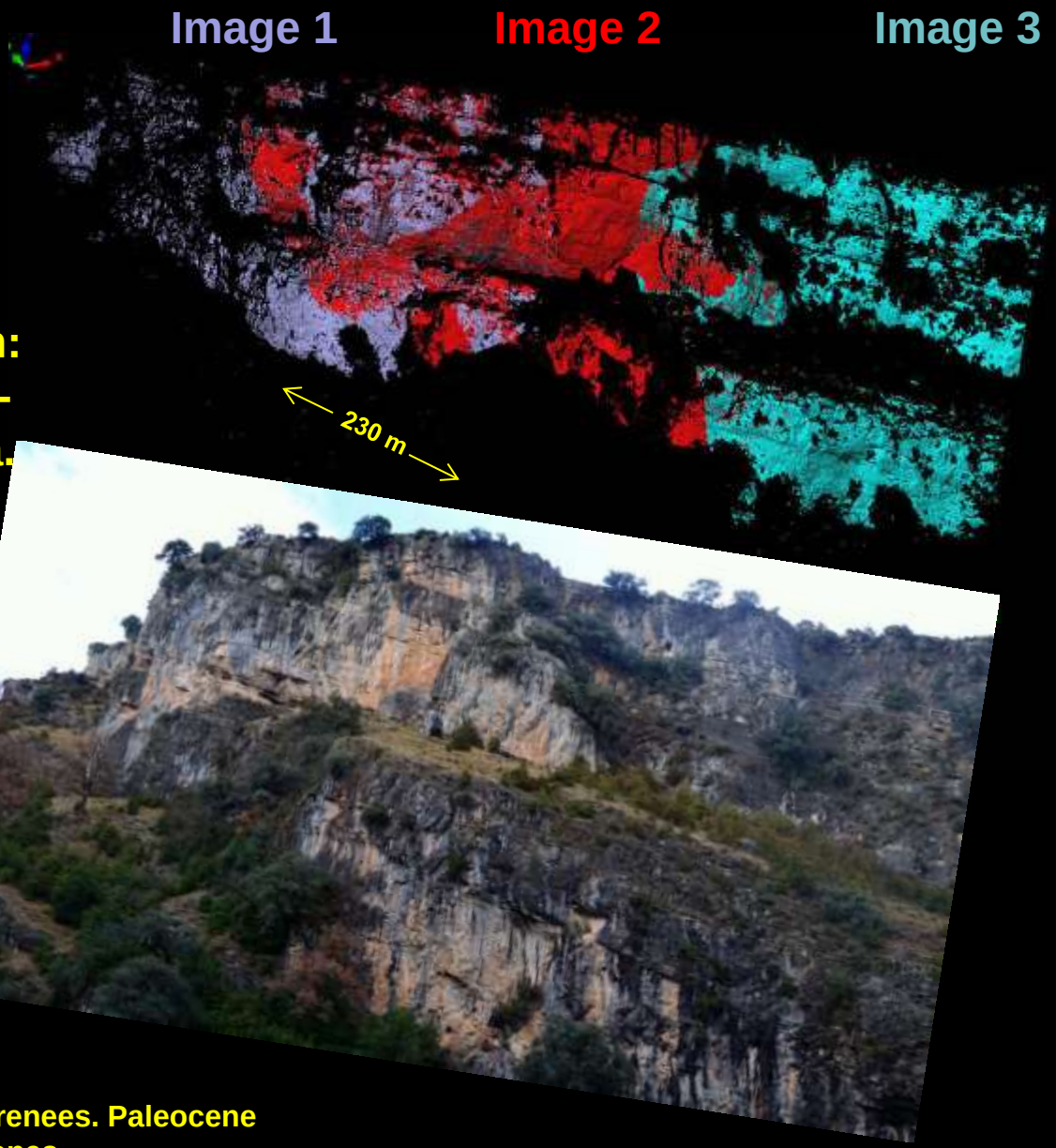
FIELD WORK

Requires logistical

High data quality

Total reliability

For advanced users in: GPS differential, post-processing Lidar data.



Añisclo anticline, Pyrenees. Paleocene limestones

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Photogrammetric SfM Equipment

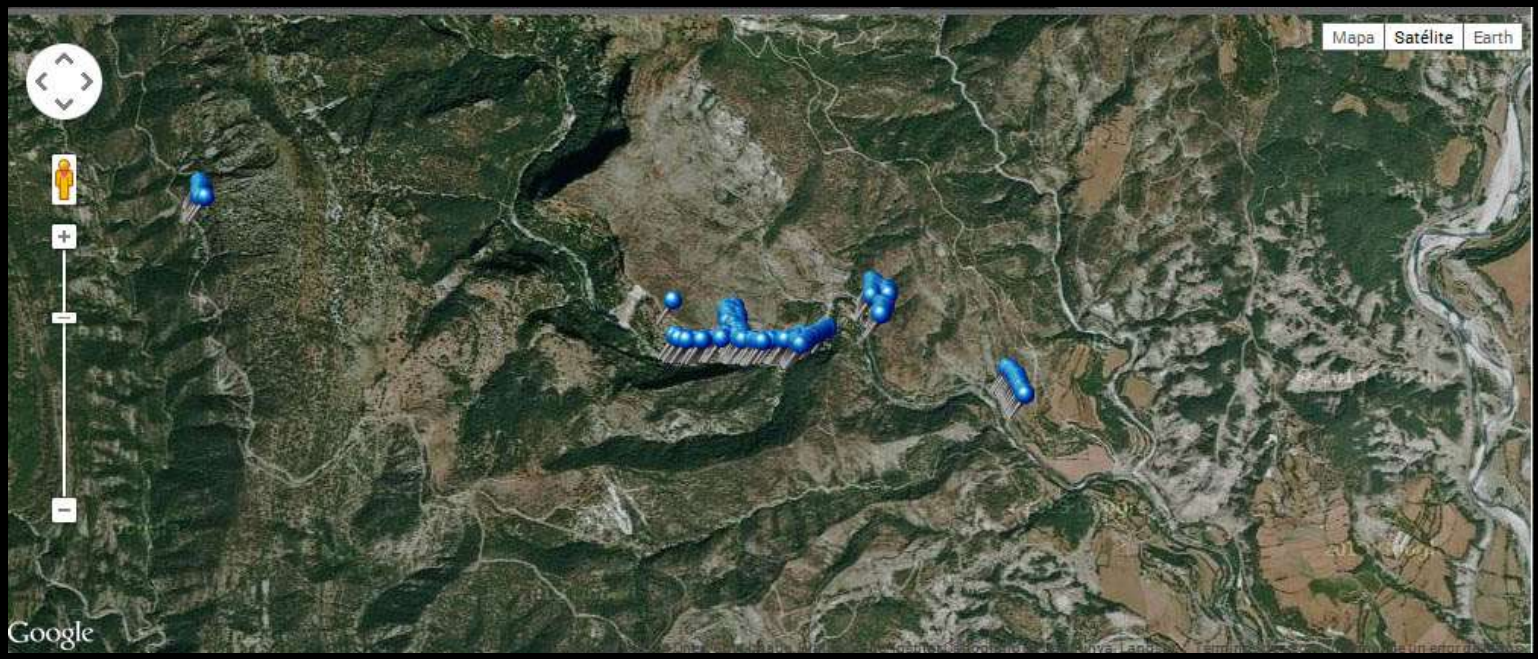
GPS device

Digital Camera

Photogrammetric SfM Equipment

GPS positioning attached to file picture (exif).

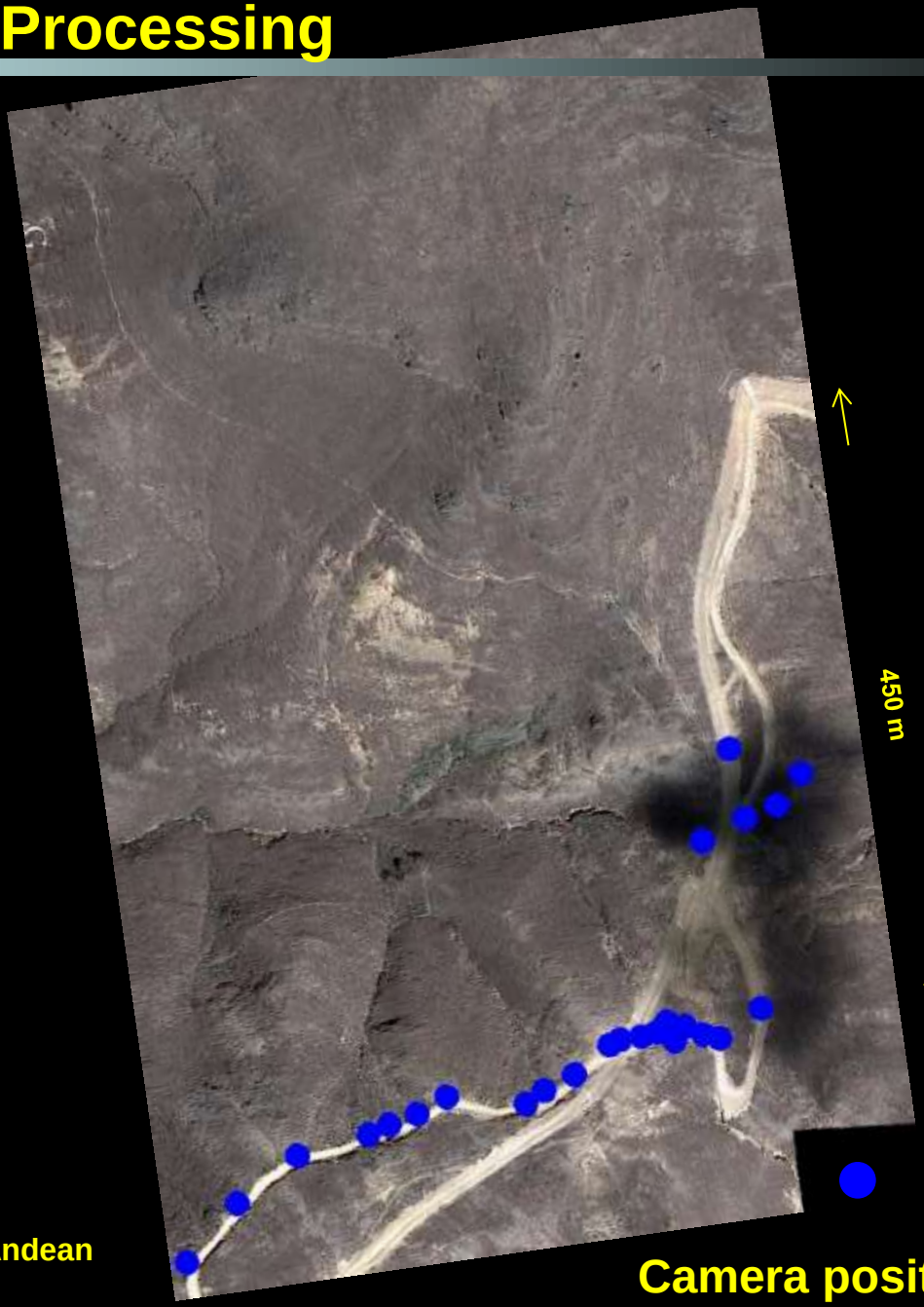
Poor precision must be compensated by a good distribution of photo-shooting



Photogrammetric SfM Processing

FIELD WORK

- Fast acquisition
- Cameras position distribution
- Standard camera



Abra del Condor anticline, Bolivia. Sub Andean Range. Sandstones

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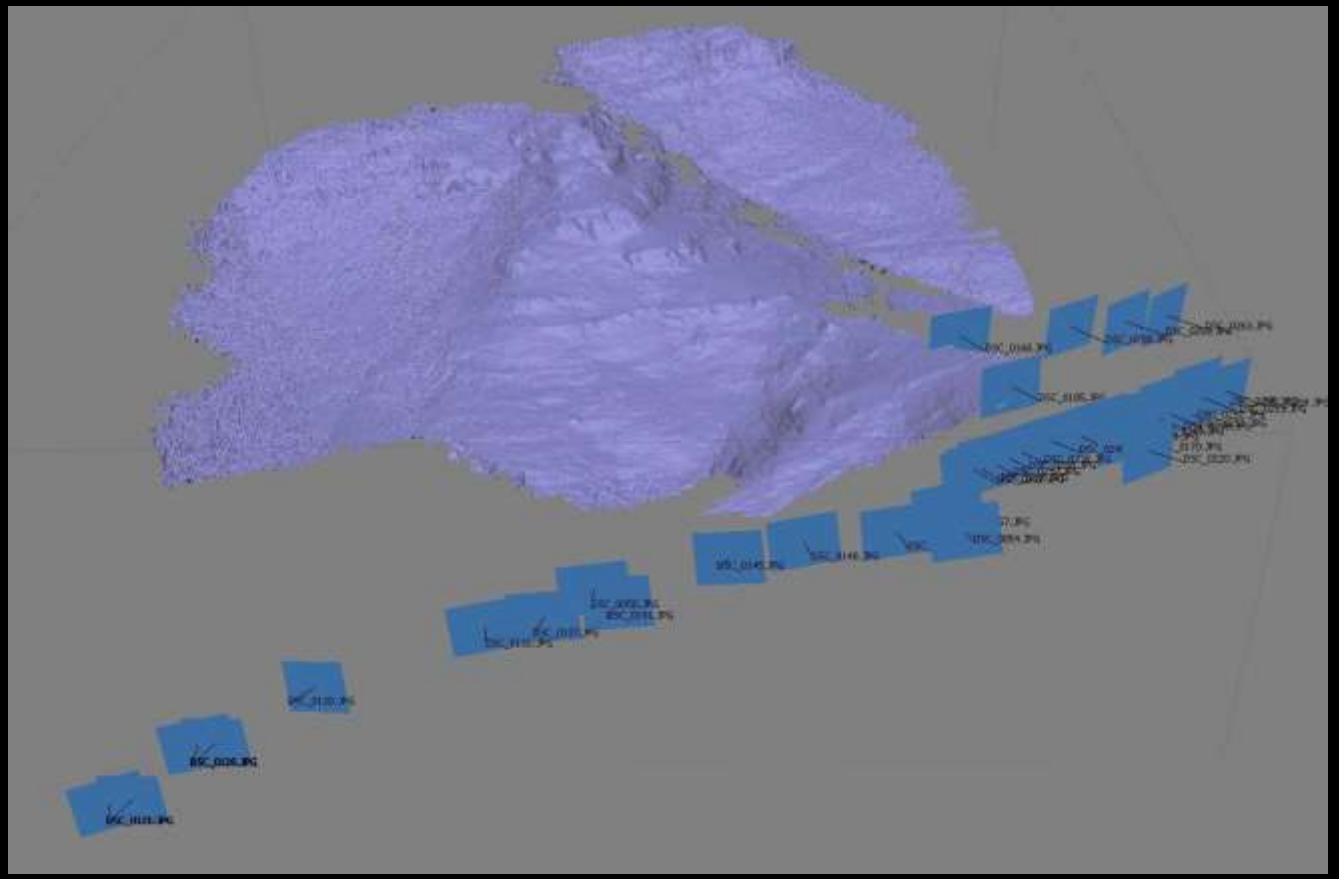
Photogrammetric SfM Processing

FIELD WORK

Medium-high data quality in accuracy and density

Uncertain result

All users



Photogrammetric Model in Render view

Abra del Condor anticline, Bolivia. Sub Andean Range. Sandstones

Photogrammetric SfM Processing

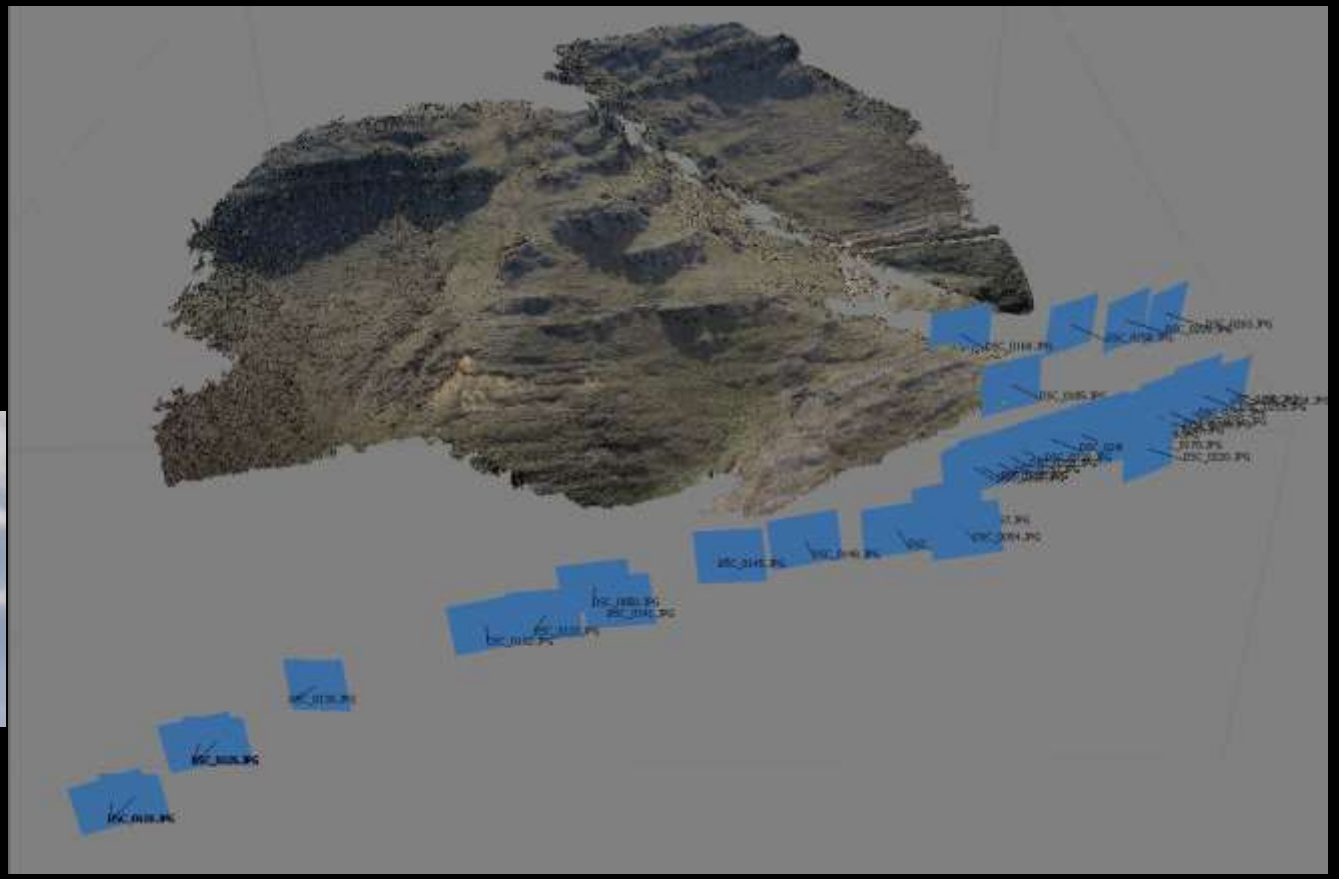
FIELD WORK

Medium-high data quality in accuracy and density

Uncertain result

All users

As a payload



Photogrammetric Model in Photorealistic view

Abra del Condor anticline, Bolivia. Subandean Range. Graystones

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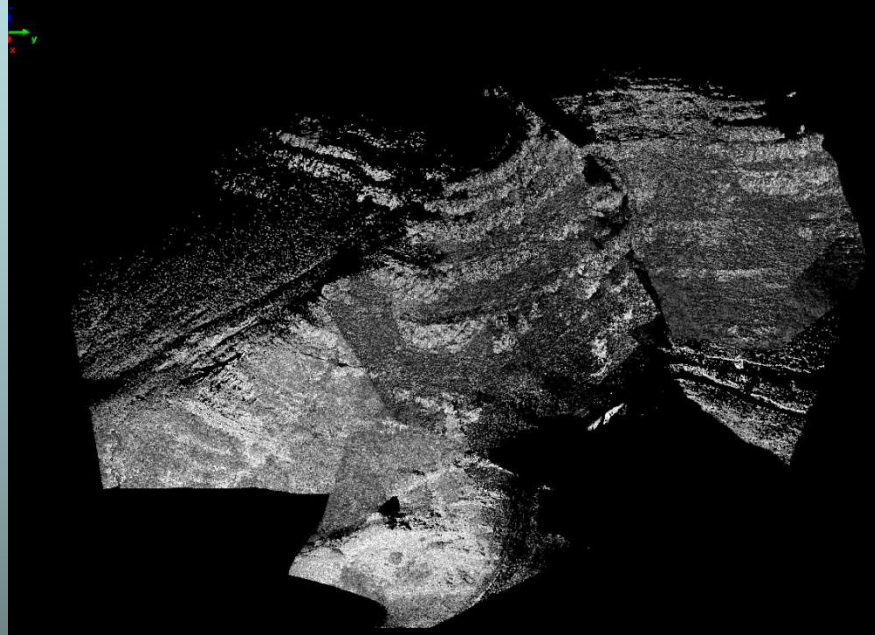
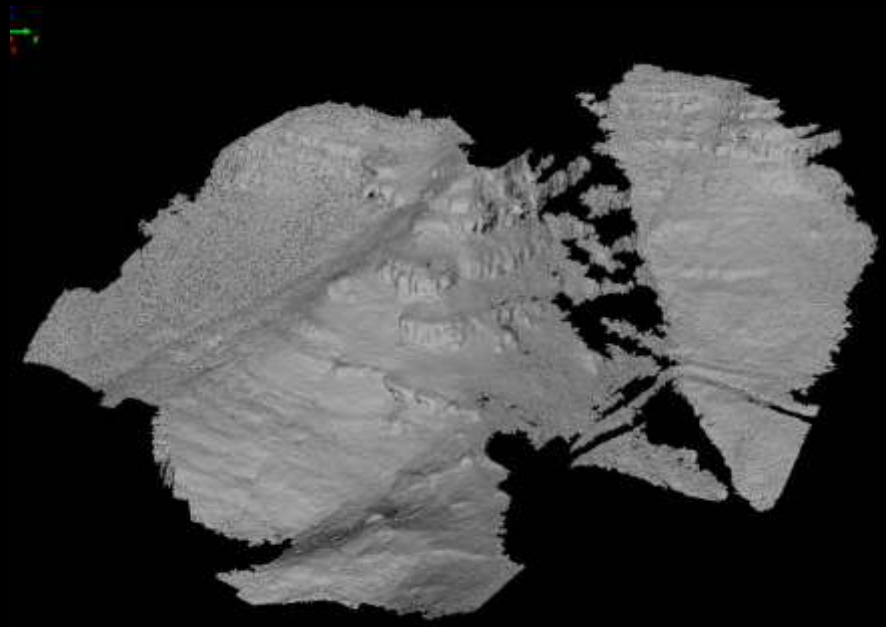
Photogrammetry Vs Lidar

FIELD WORK



Lidar Model



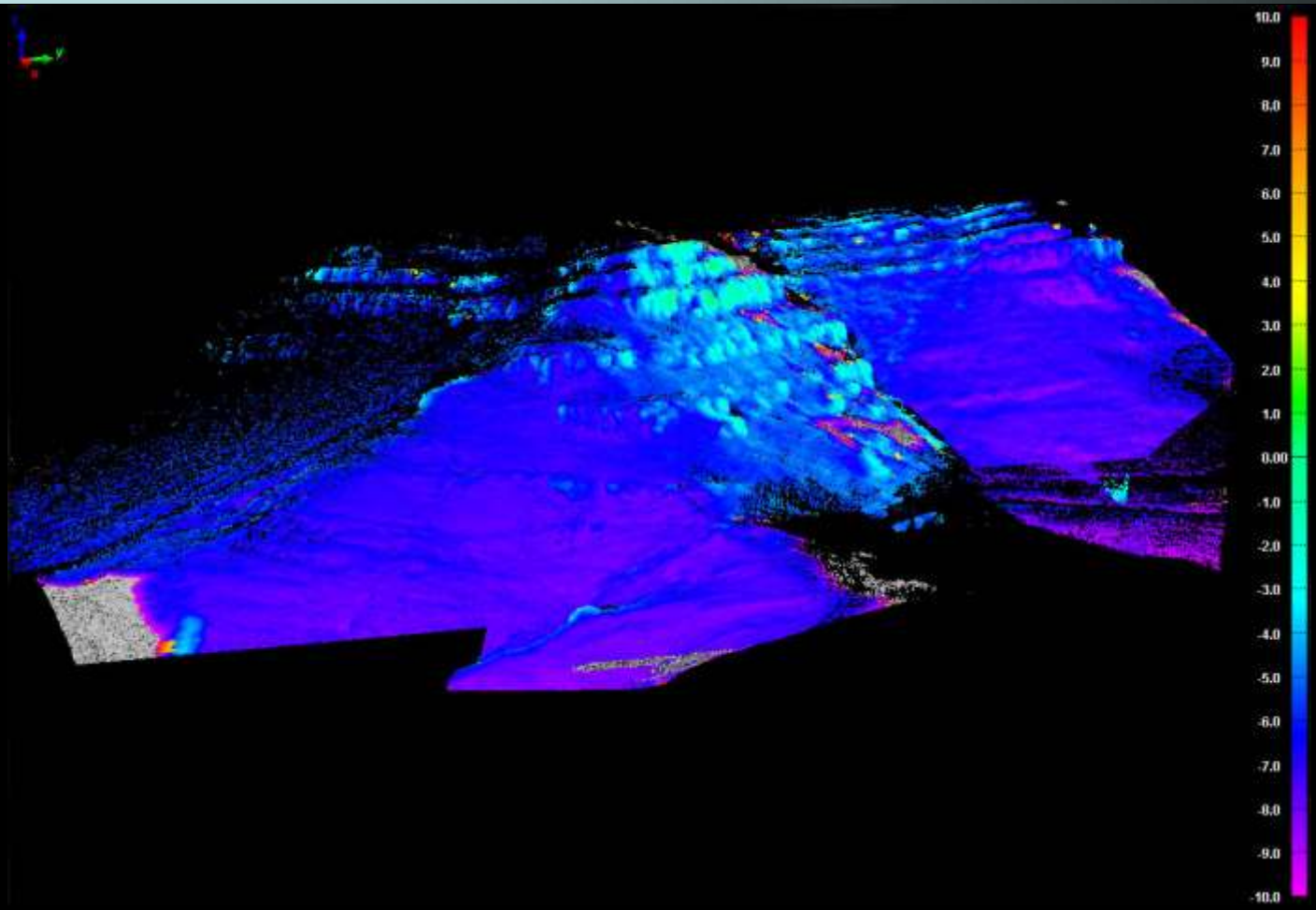
Photogrammetric Model

Differences in GPS devices: Scale Azimuth Dip Positioning

Abra del Condor anticline, Bolivia. Sub Andean Range. Sandstones

Photogrammetry Vs Lidar

FIELD WORK

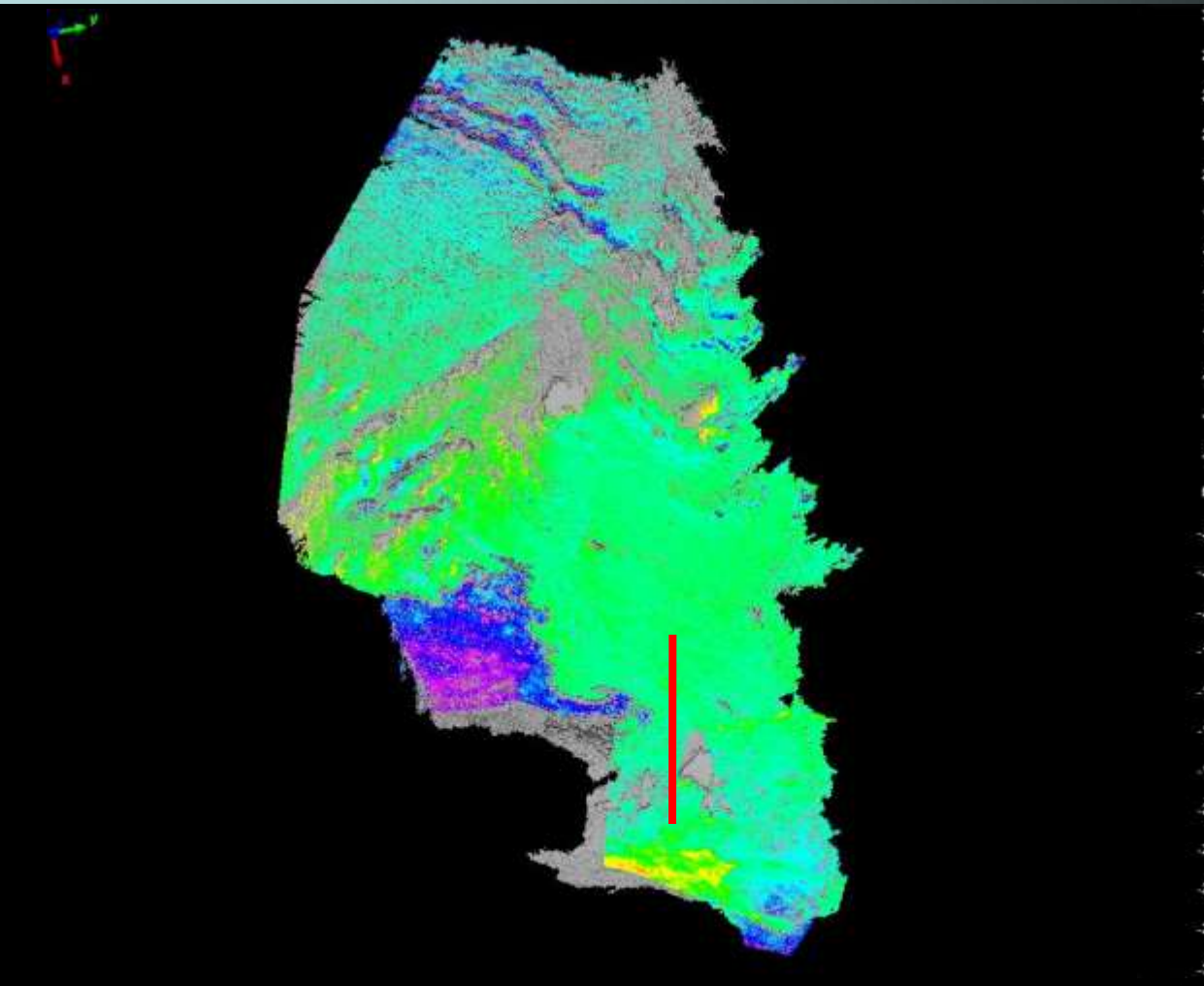


Differences in GPS devices:	Scale	Azimuth	Dip	Positioning
	√	√	√	●

Abra del Condor anticline, Bolivia. Sub Andean Range. Sandstones

Photogrammetric Vs Lidar

FIELD WORK



Offset corrected

Abra del Condor anticline, Bolivia. Sub Andean Range. Sandstones

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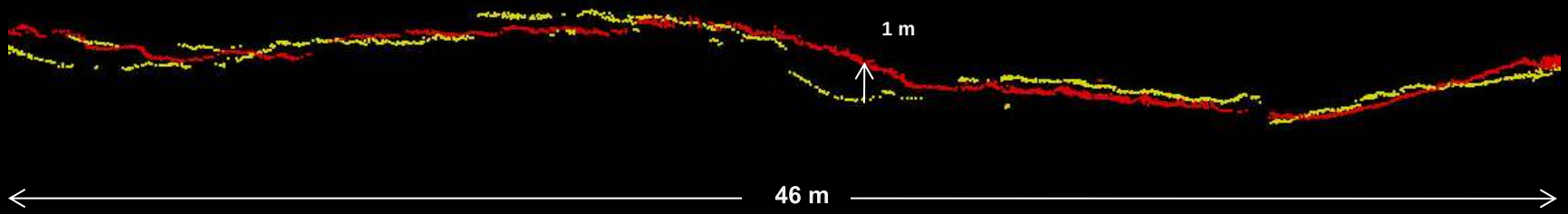
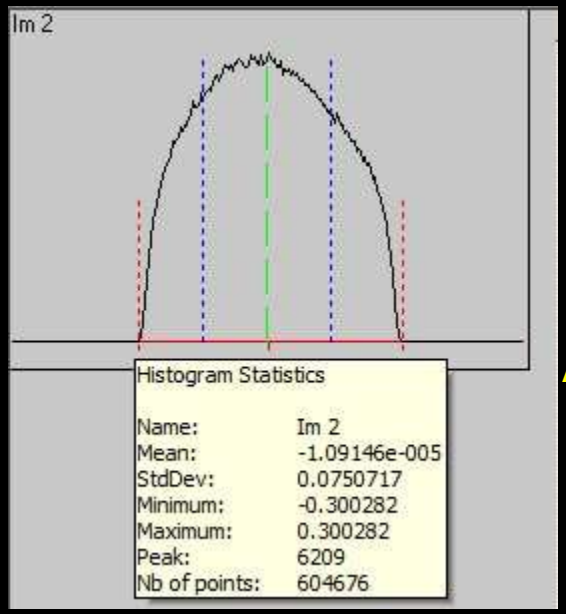
Photogrammetric Vs Lidar

FIELD WORK

Comparative profile: Lidar Model – Photogrammetric Model

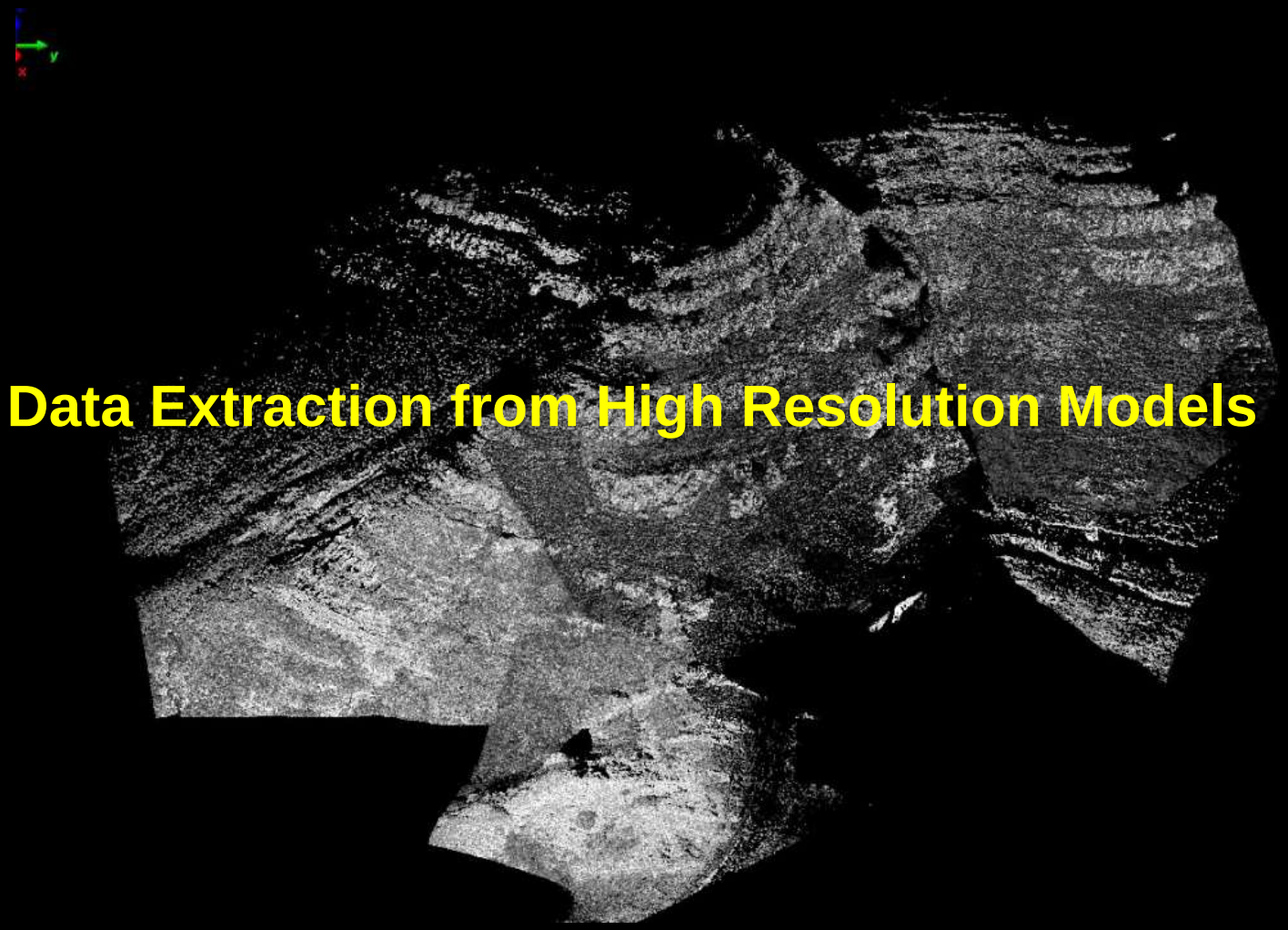




Alignment histogram models

Abra del Condor anticline, Bolivia. Sub Andean Range. Sandstones

Data Extraction from High Resolution Models

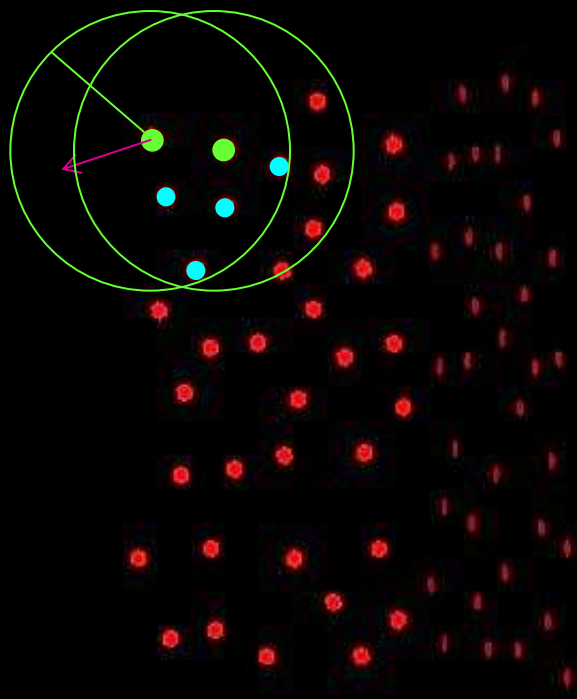


Surfaces

Data extraction: Vectorizing point clouds algorithm

Parameters obtained:

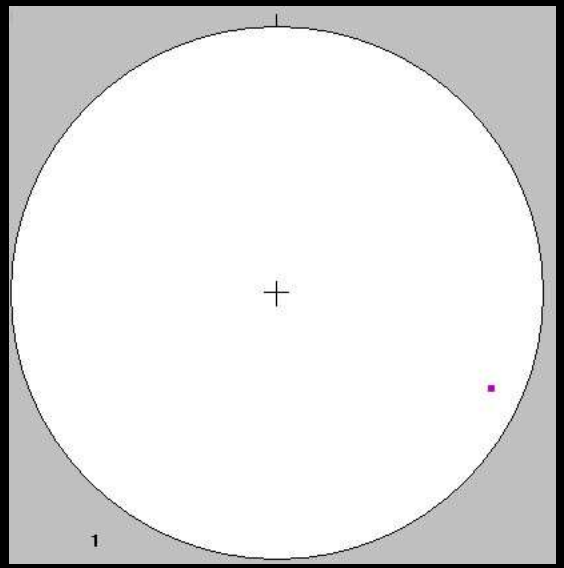
- Vector orientation — Azimuth, Dip
- Degree of fit (coplanarity, M)
- Reliability (colinearity, K)
- Points by regression



Point Cloud

Simplified geometric surfaces

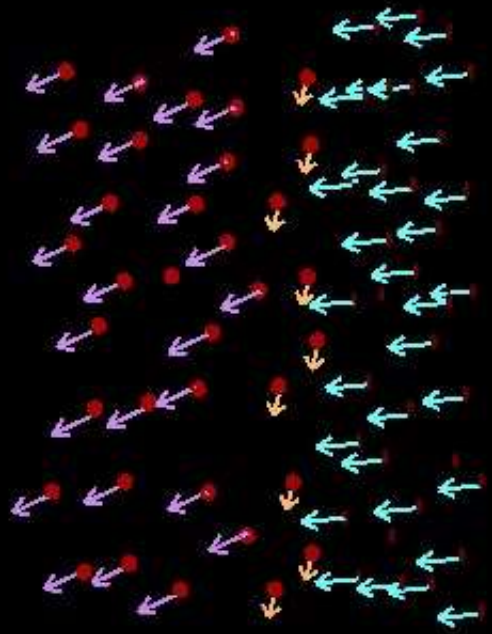
Stereoplot



Data extraction from surfaces: Planar regression by Moment of Inertia analysis

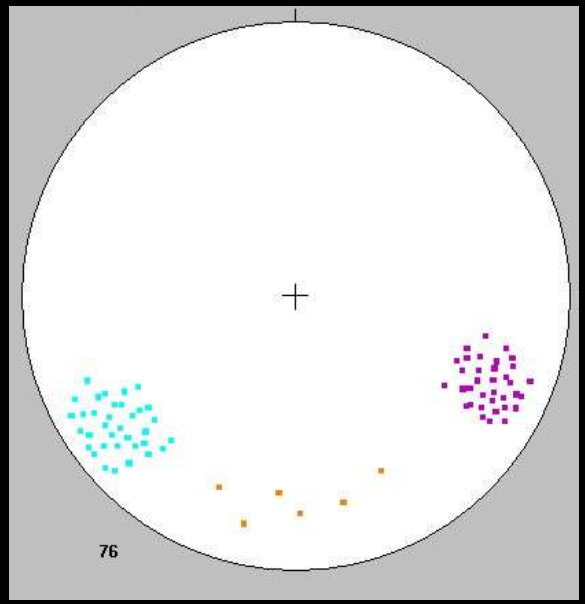
Parameters obtained:

- Vector orientation
  - Azimuth
  - Dip
- Degree of fit (coplanarity, M)
- Reliability (colinearity, K)
- Points by regression

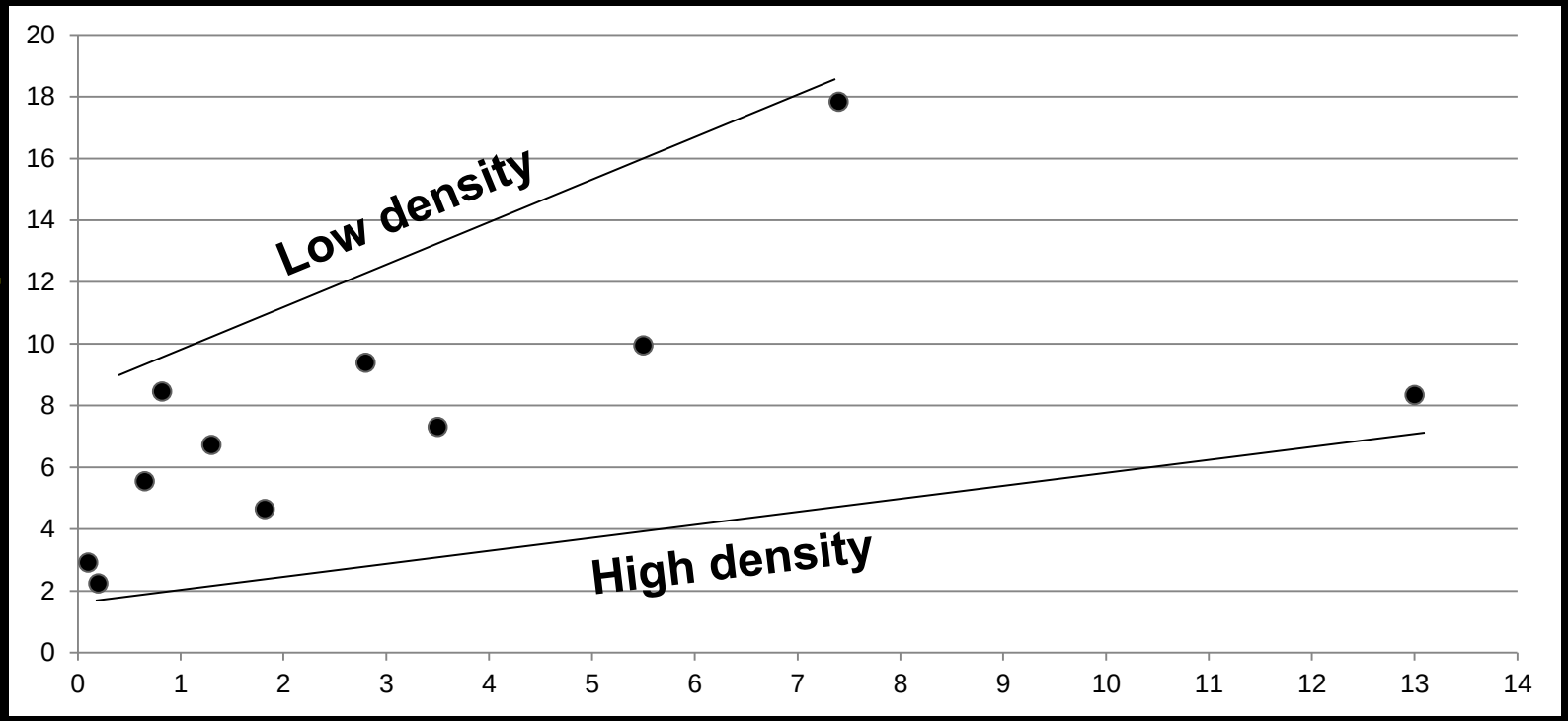


Point Cloud

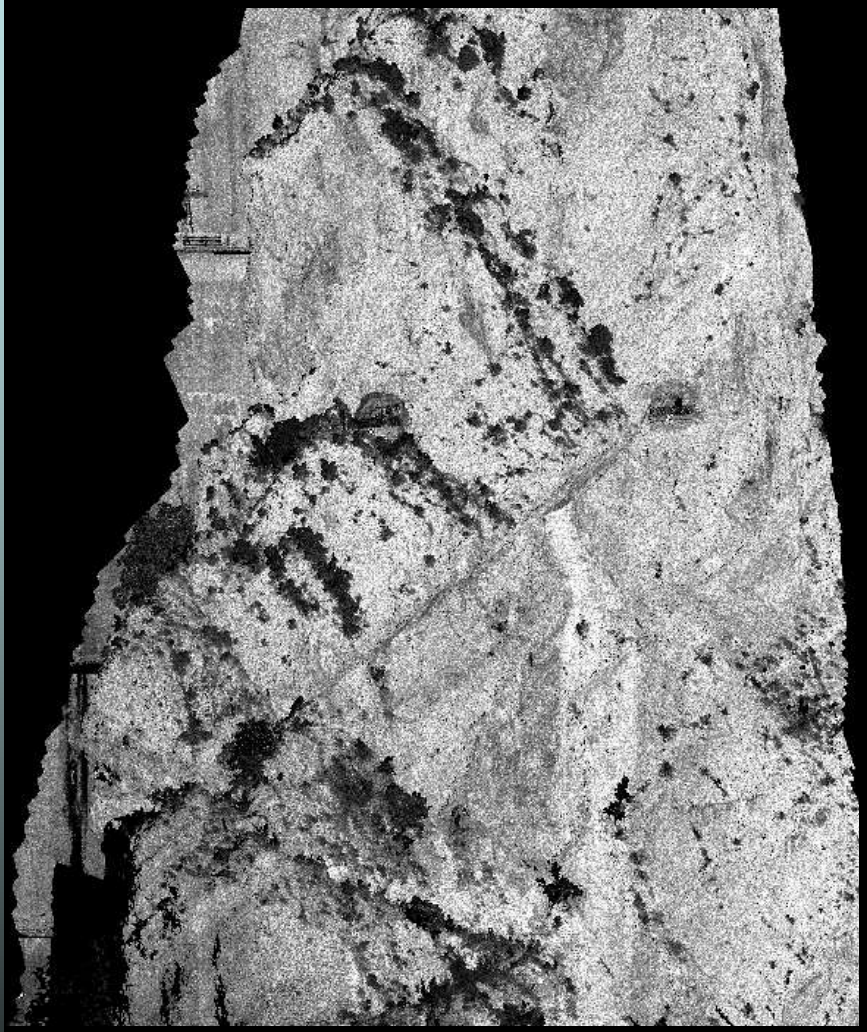
Stereoplot

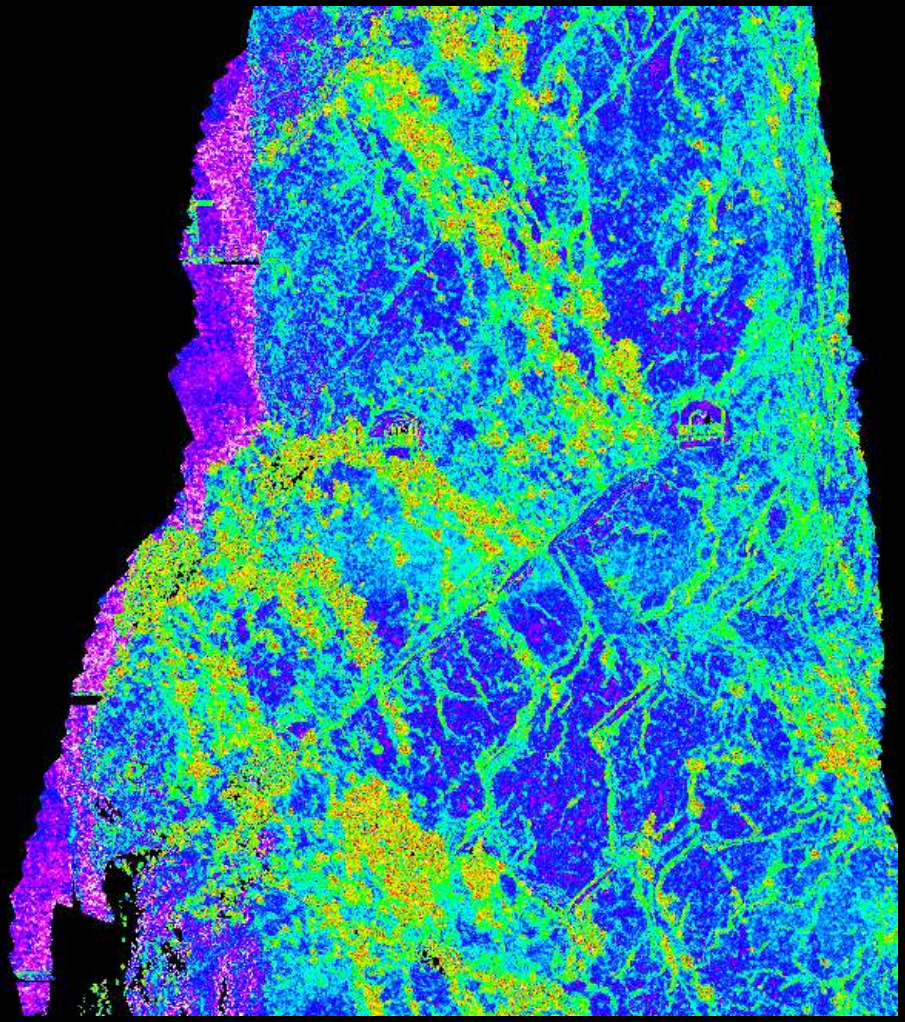


Data extraction from surfaces: Outcrop vectorization



Data extraction from surfaces: Planar regression by Moment of Inertia analysis

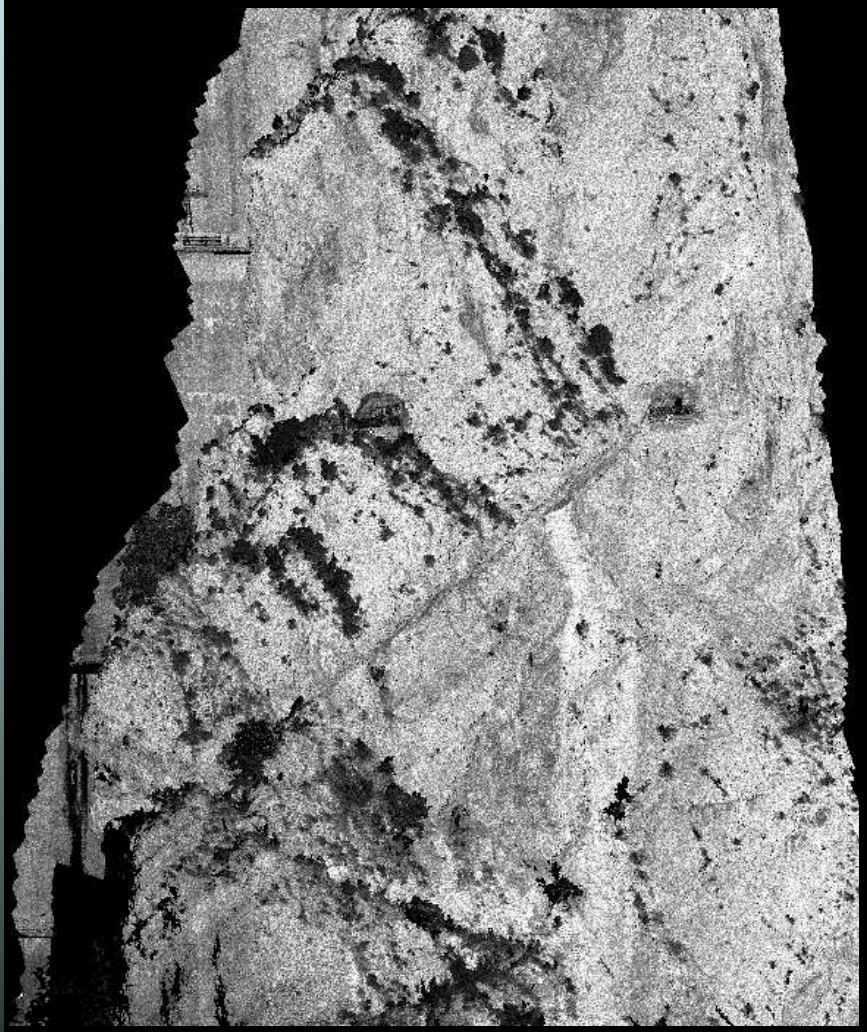


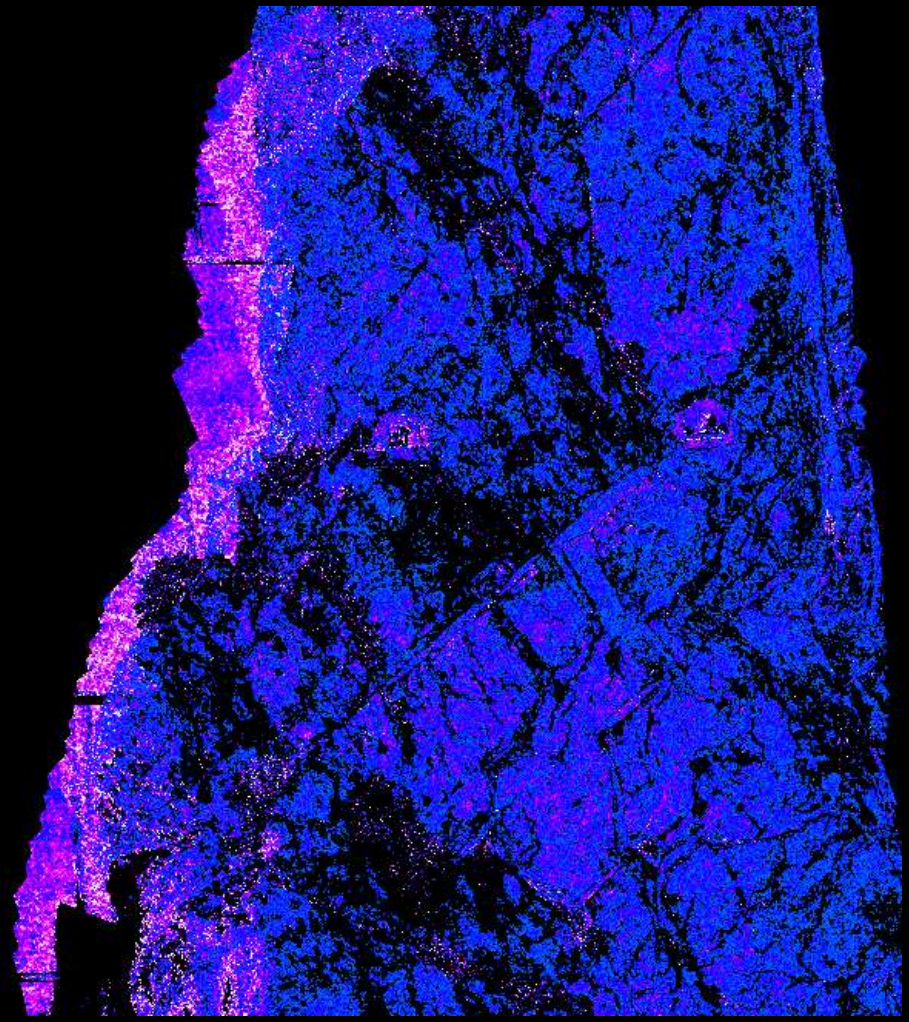


Coplanarity Index

0 6.2

Data extraction from surfaces: Planar regression by Moment of Inertia analysis

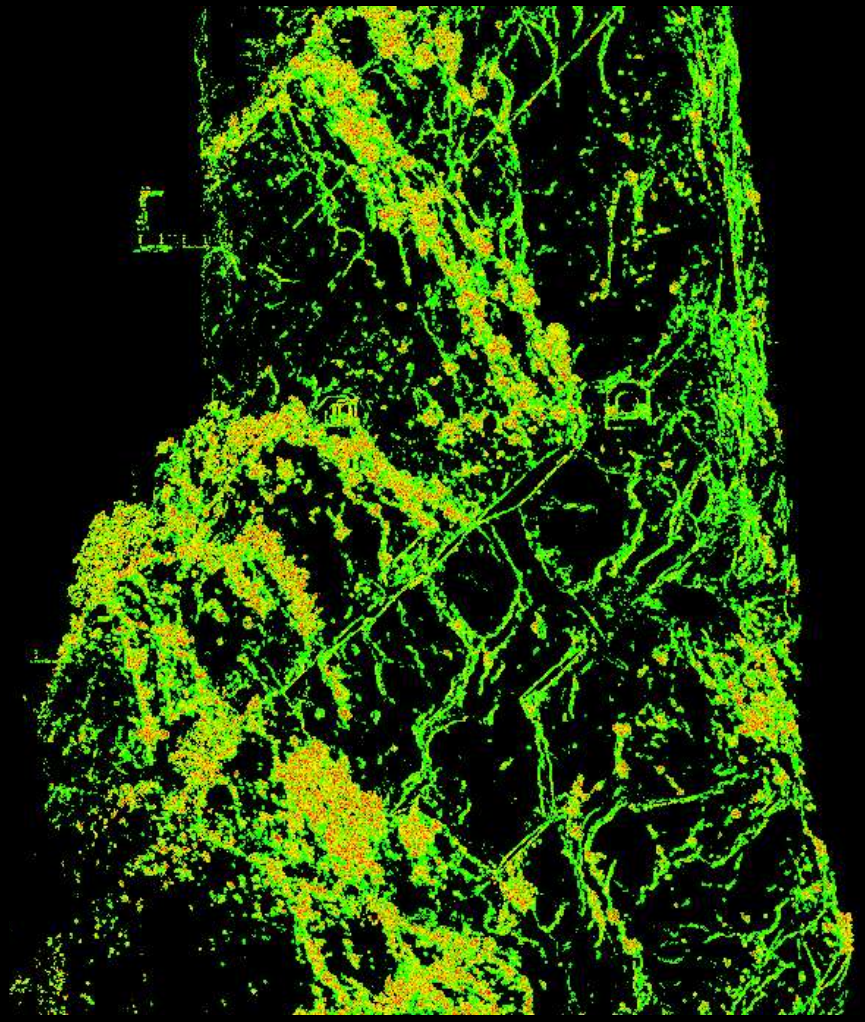




Coplanarity Index mask

0 6.2

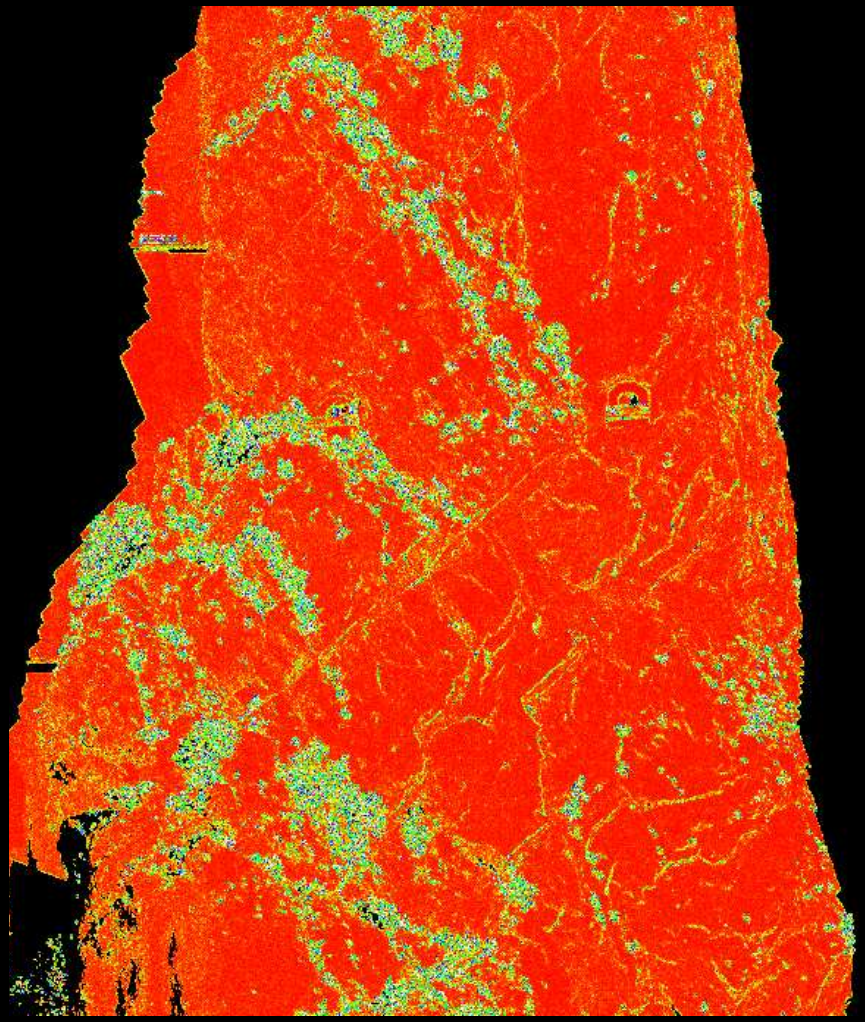
Data extraction from surfaces: Planar regression by Moment of Inertia analysis



Coplanarity Index mask

0 6.2

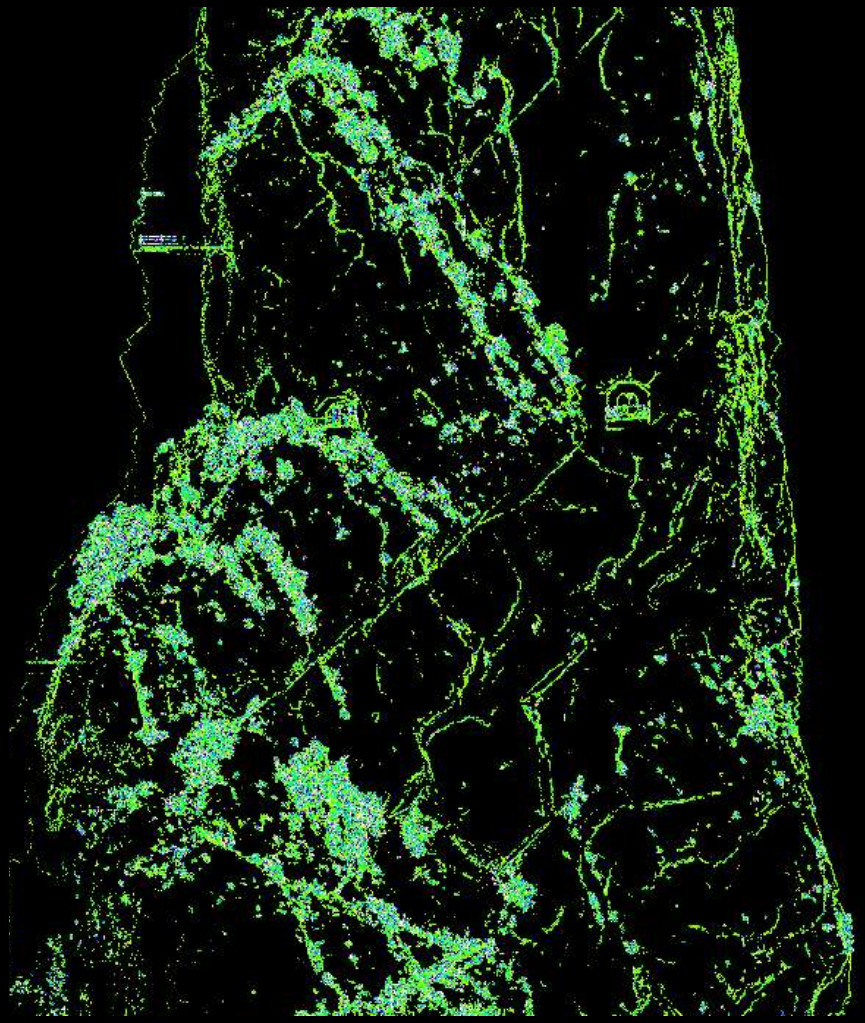
Data extraction from surfaces: Planar regression by Moment of Inertia analysis



Colinearity Index

0 — 2

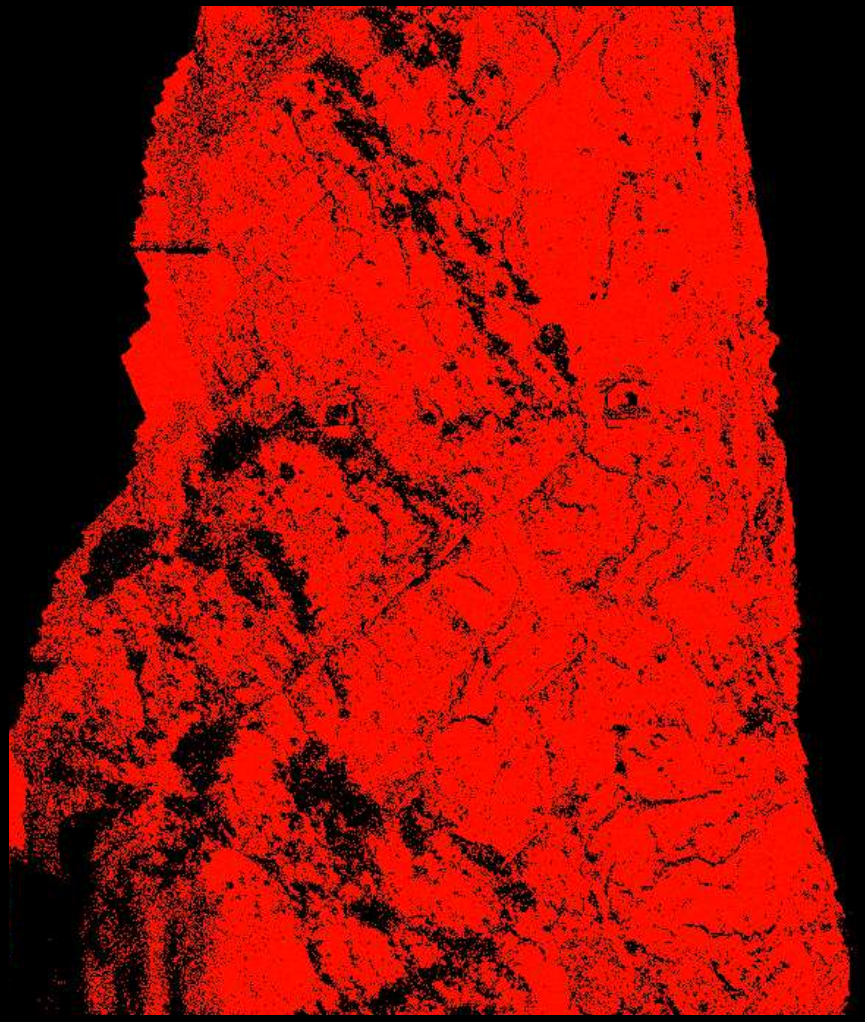
Data extraction from surfaces: Planar regression by Moment of Inertia analysis



Colinearity Index mask

0 — 2

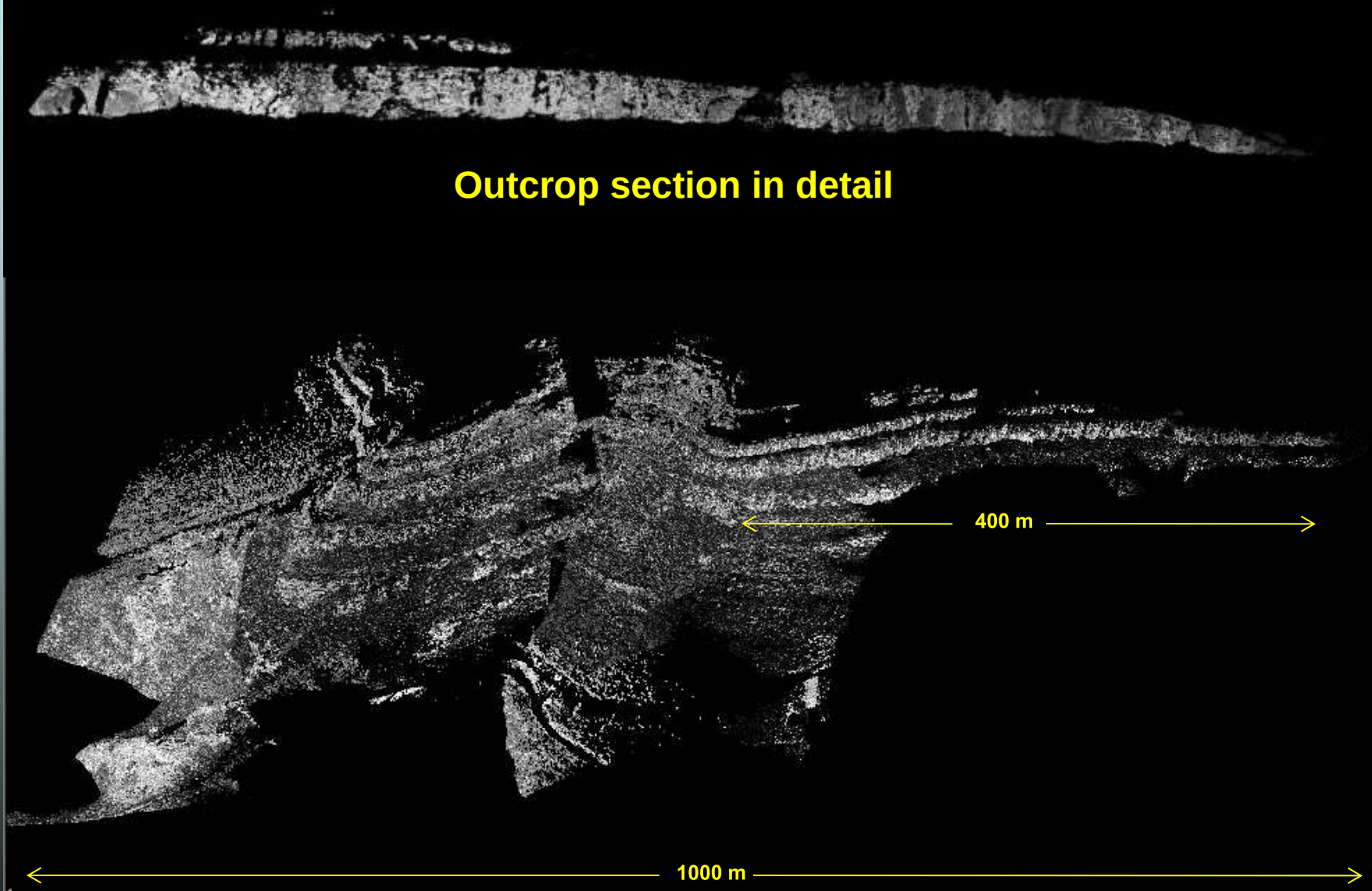
Data extraction from surfaces: Planar regression by Moment of Inertia analysis



Colinearity Index mask

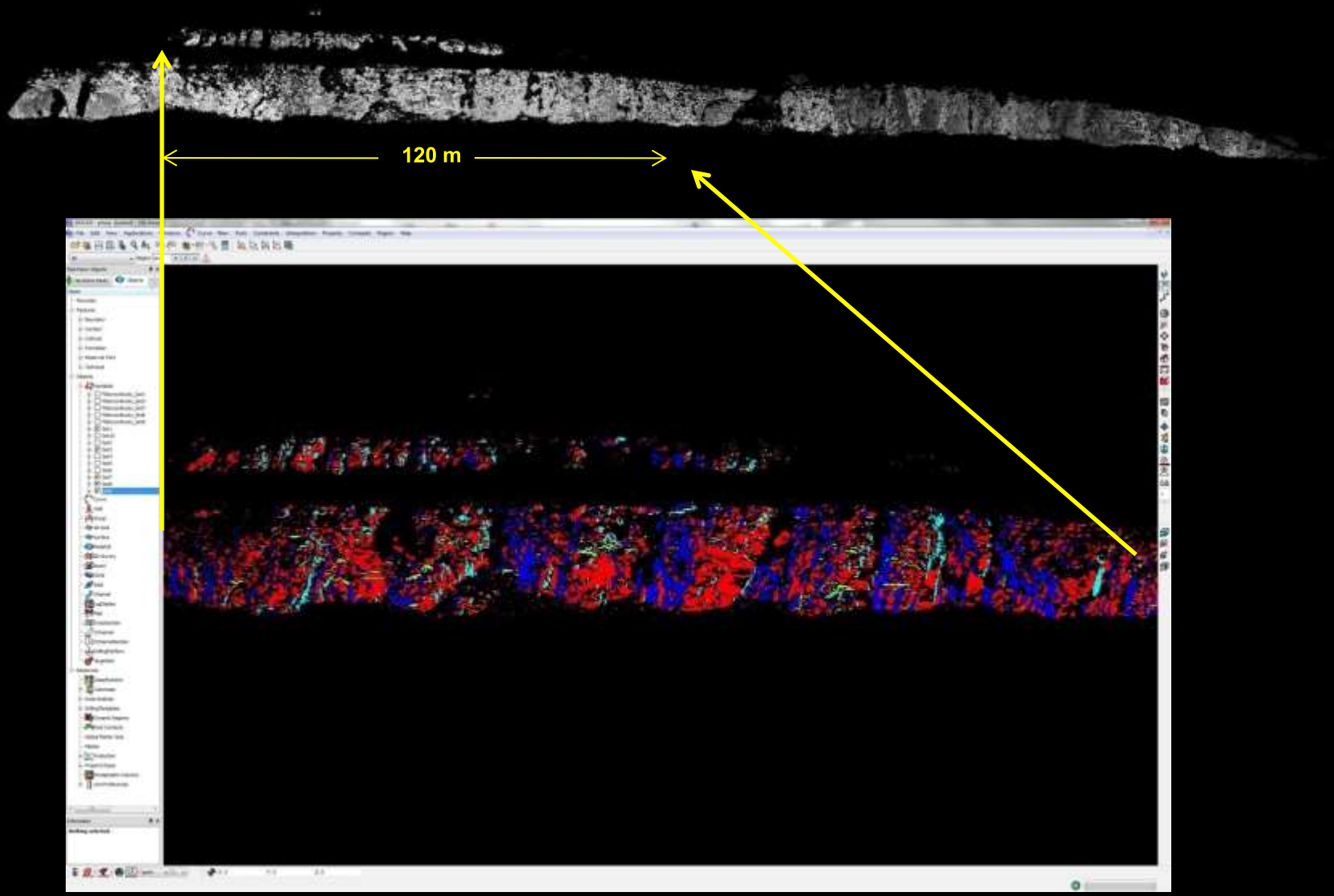
0 — 2

Data extraction from surfaces: Outcrop vectorization



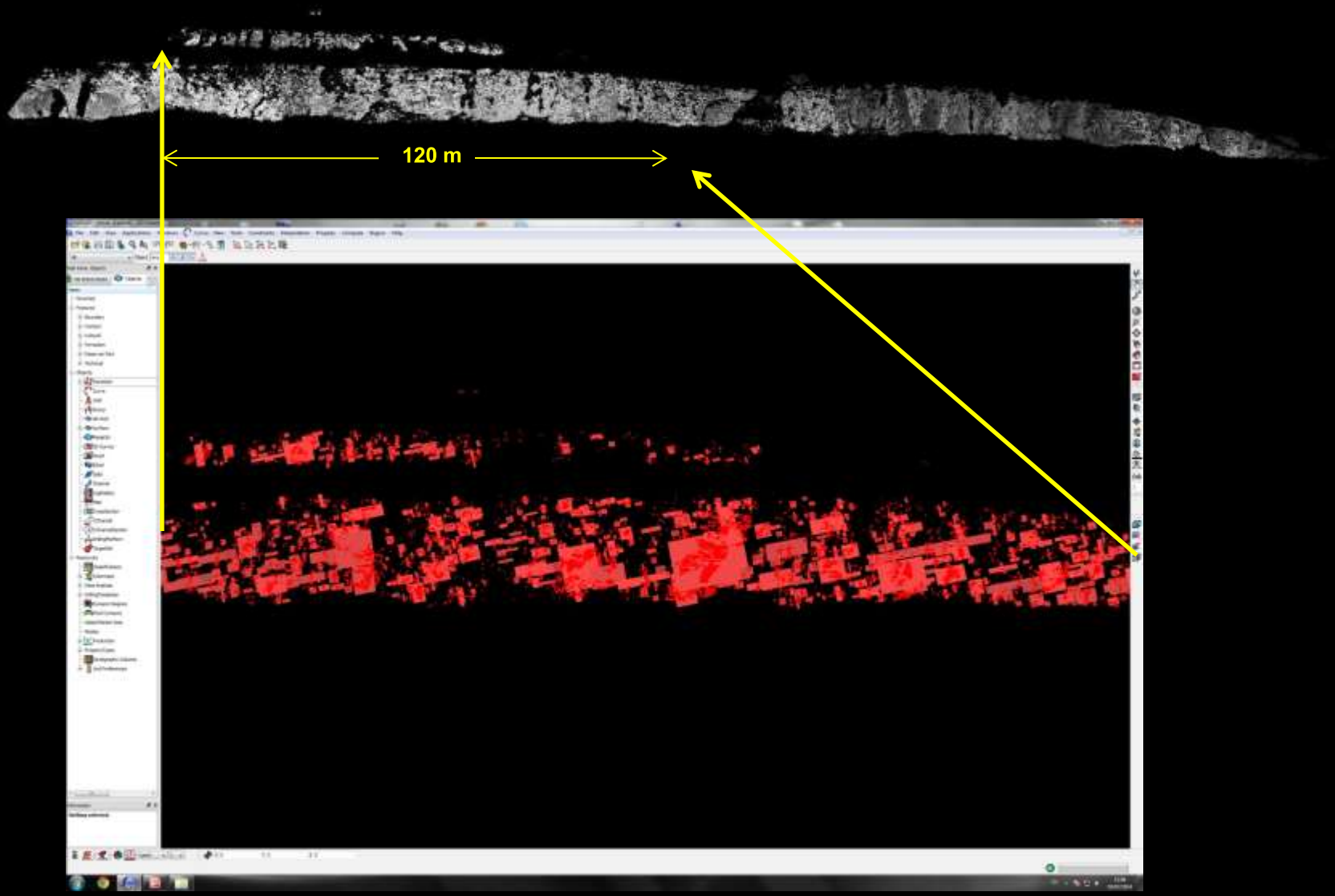
Abra del Condor anticline, Bolivia. Sub Andean Range. Sandstones

Data extraction from surfaces : Azimuth –Dip classification by sets



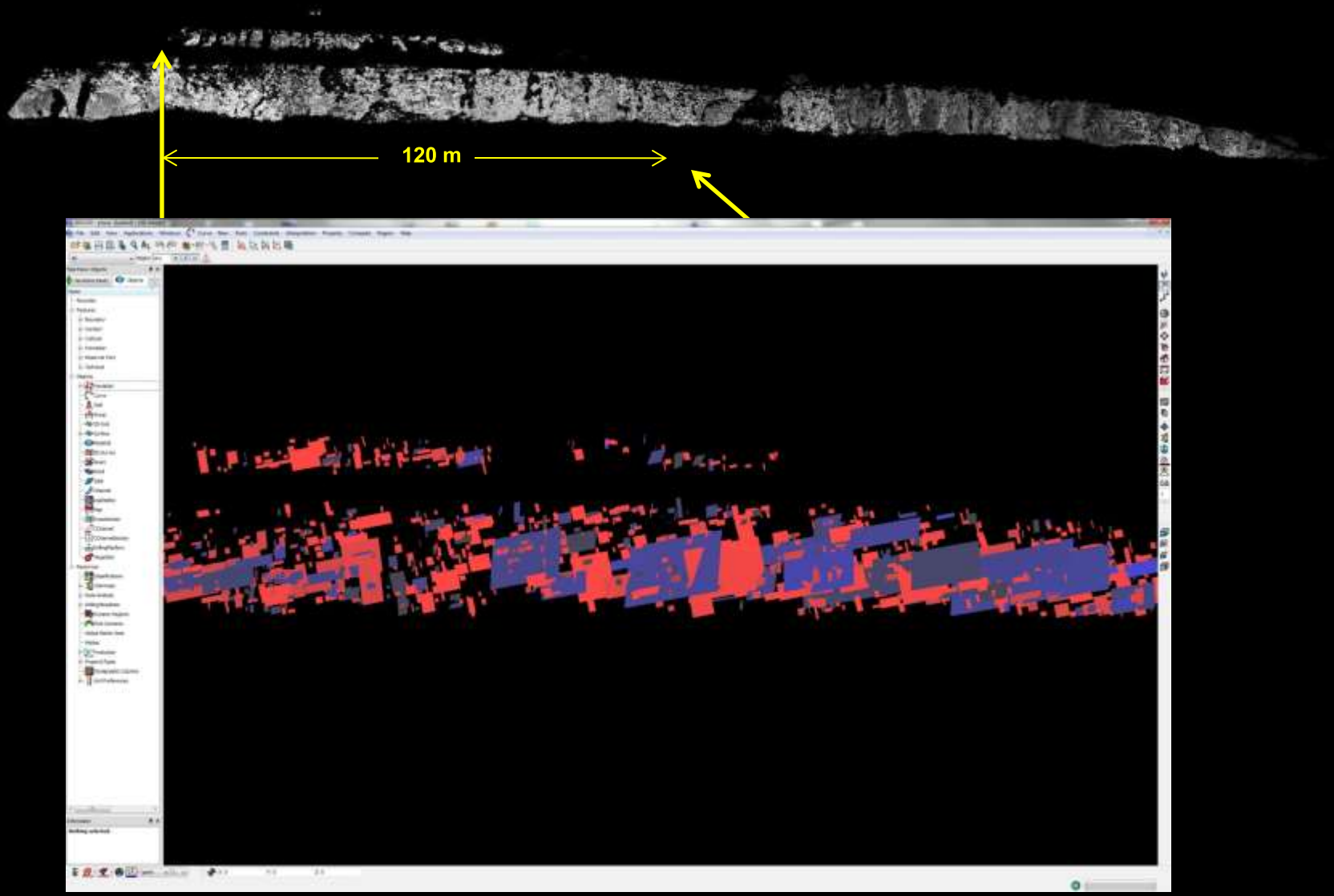
Fracture Sets

Data extraction from surfaces : Isolate clusters-Reconstruct surfaces



Fracture Sets

Data extraction from surfaces : Isolate patches-Reconstruct surfaces

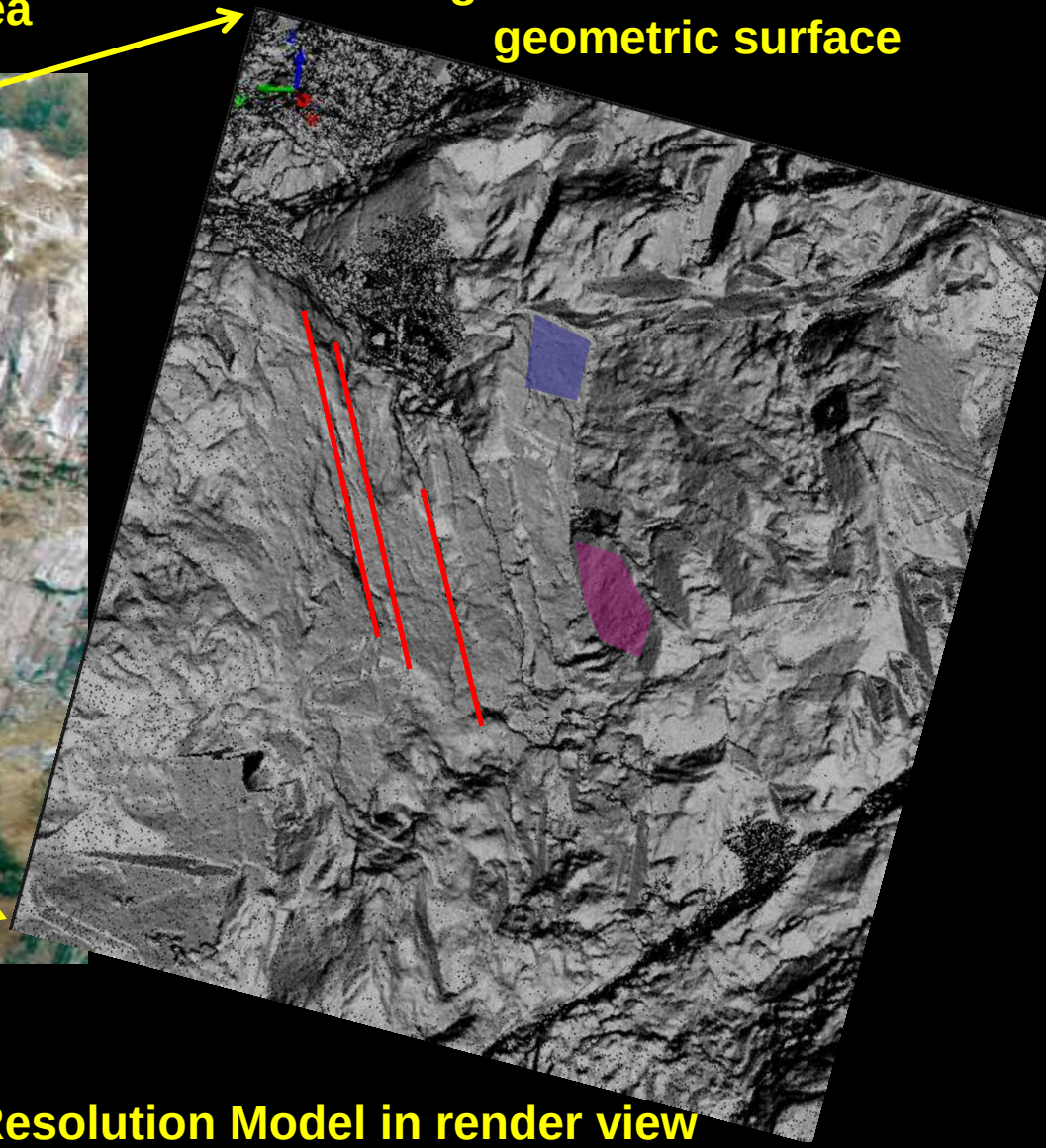


Morphological Model

Data extraction

Point cloud area

Geological feature as geometric lineation or geometric surface



RGB Image

High Resolution Model in render view

Data extraction from lineations: Image-Model link by Colinearity equation

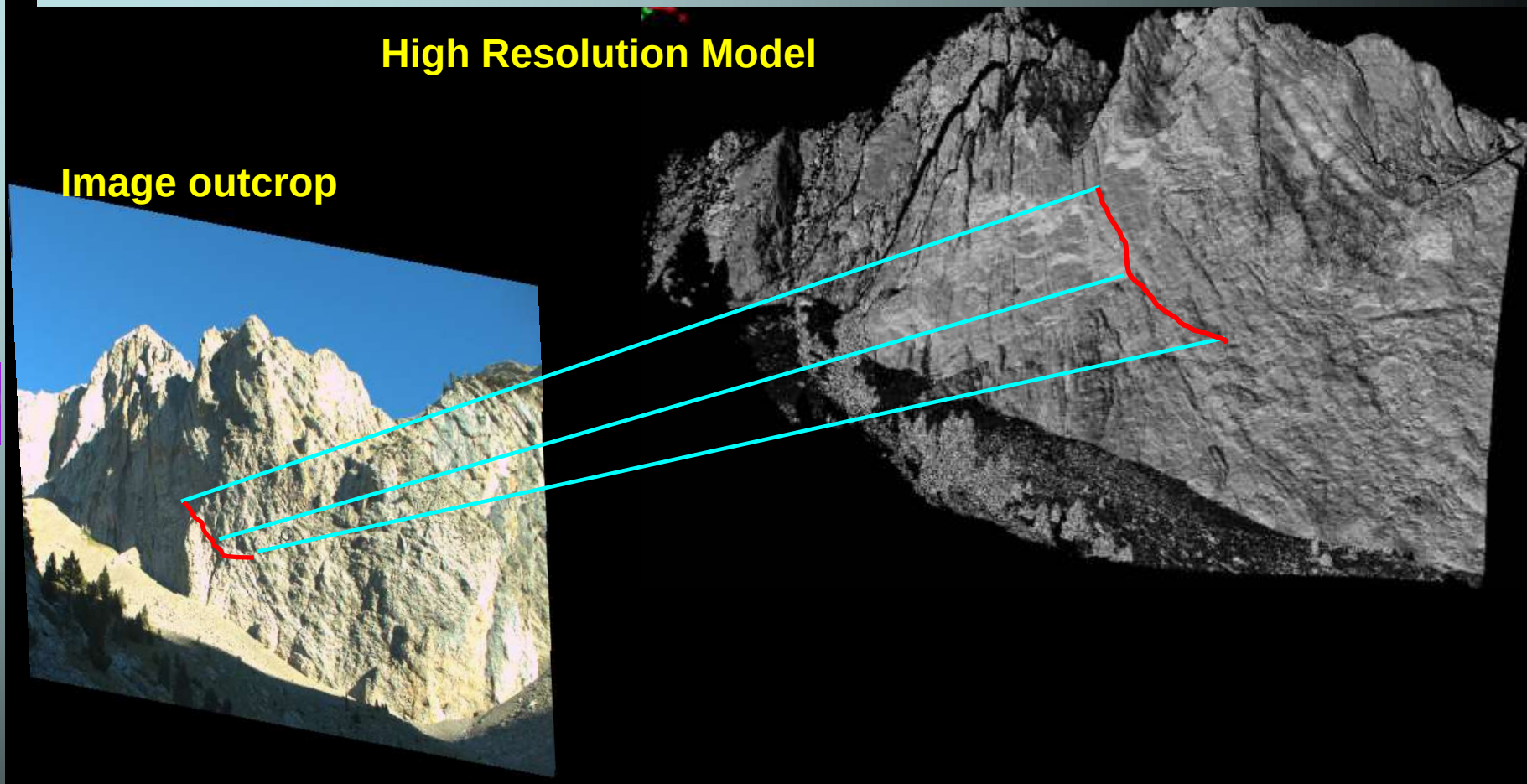


Image coordinate X_i, Y_i

Camera position

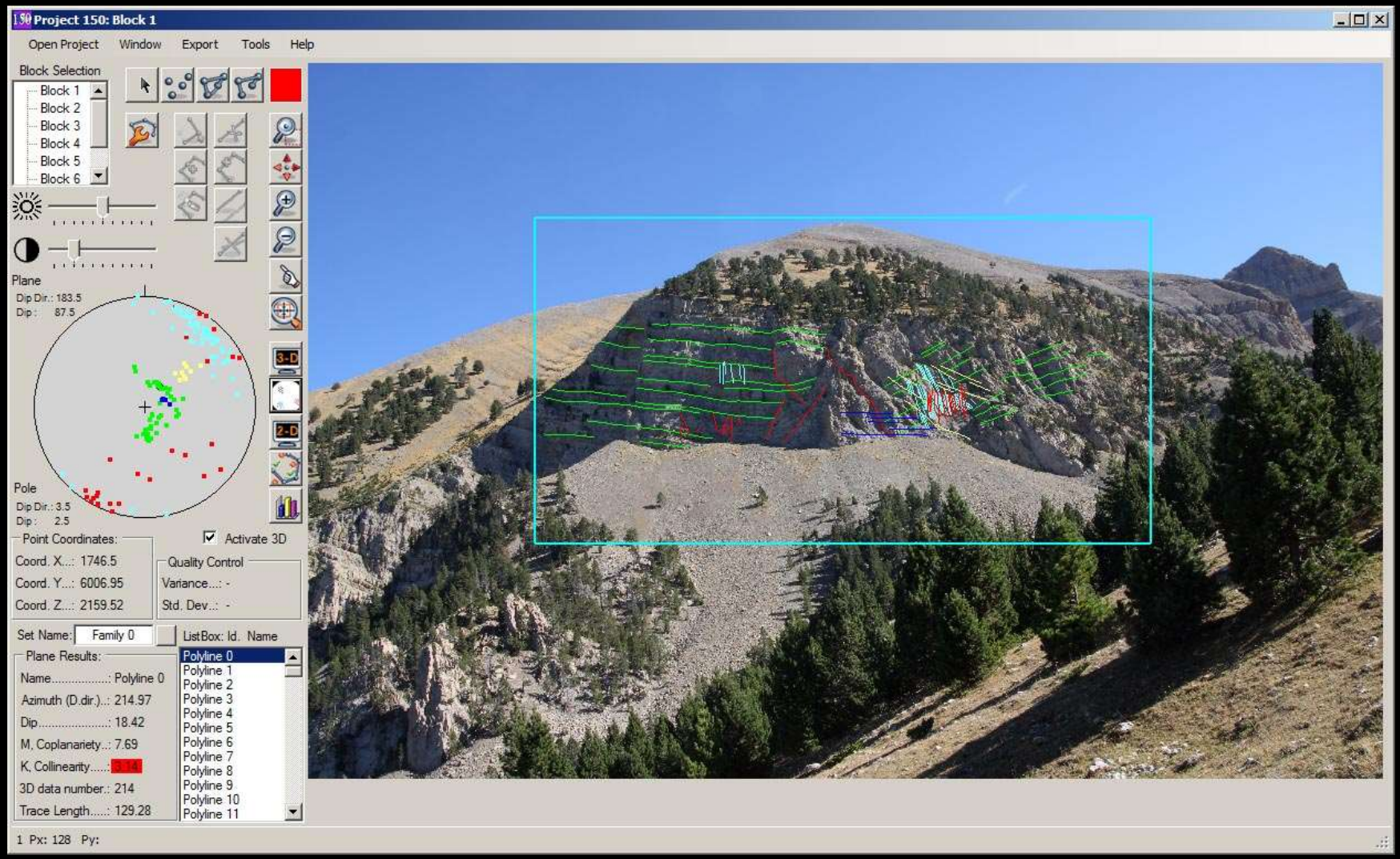
Camera orientation

Focal length, lens distortion

Model Coordinate: X_m, Y_m, Z_m

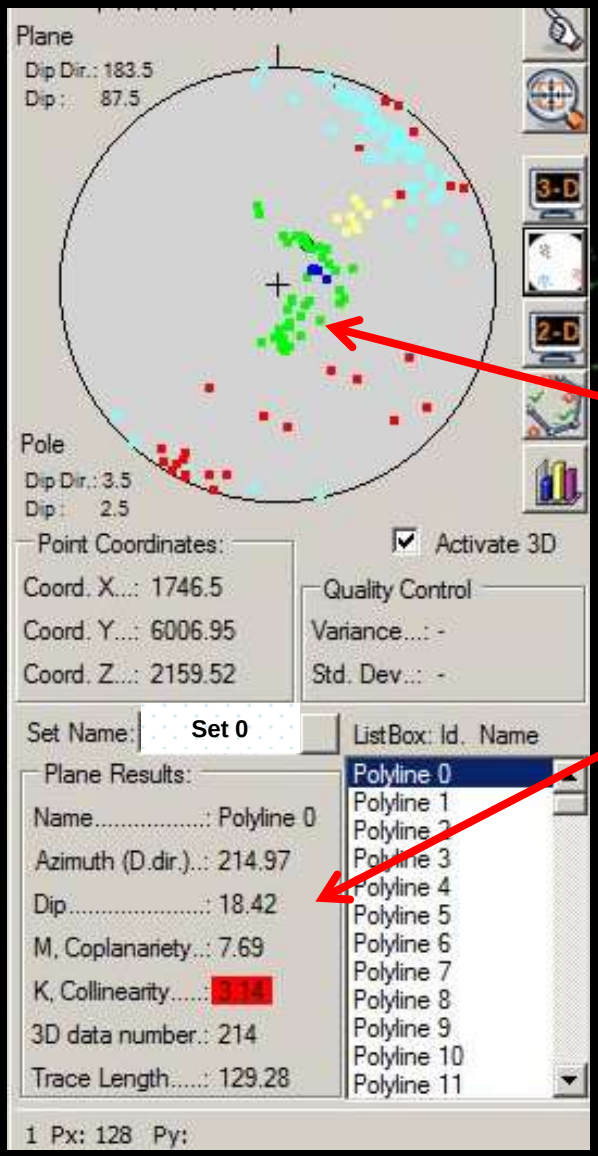
Cotiella Massif, Pyrenees. Cenomanian limestones

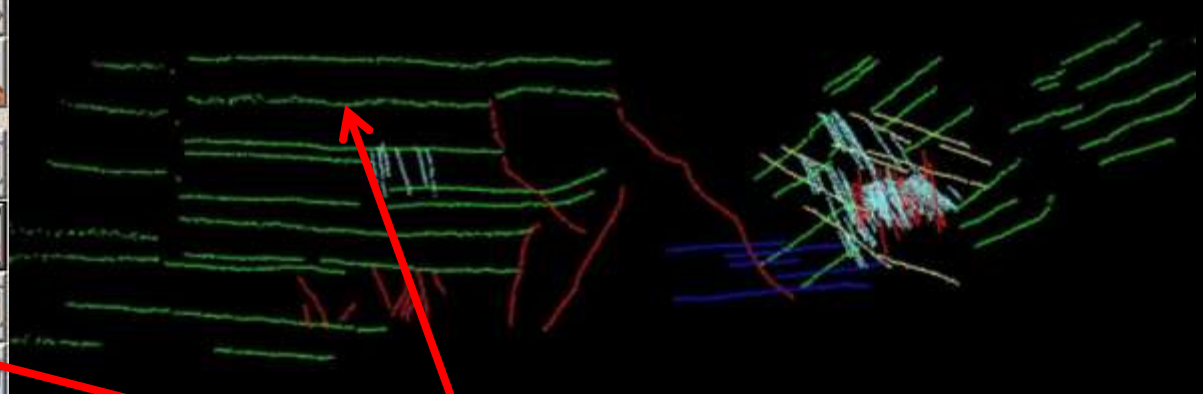
Data extraction from lineations: Software implementation



Cotiella Massif, Pyrenees. Cenomanian limestones

Data extraction from lineations: Software implementation





Stereoplot

Points Selected by digitalizing

Planar regression calculated by the Inertial Moment

Parameters obtained:

- Vector orientation { Azimut, Dip
- Degree of fit (coplanarity, M)
- Reliability (colinearity, K)
- Number of used points
- Trace length

Cotiella Massif, Pyrenees. Cenomanian limestones

Data extraction from lineations: Software implementation

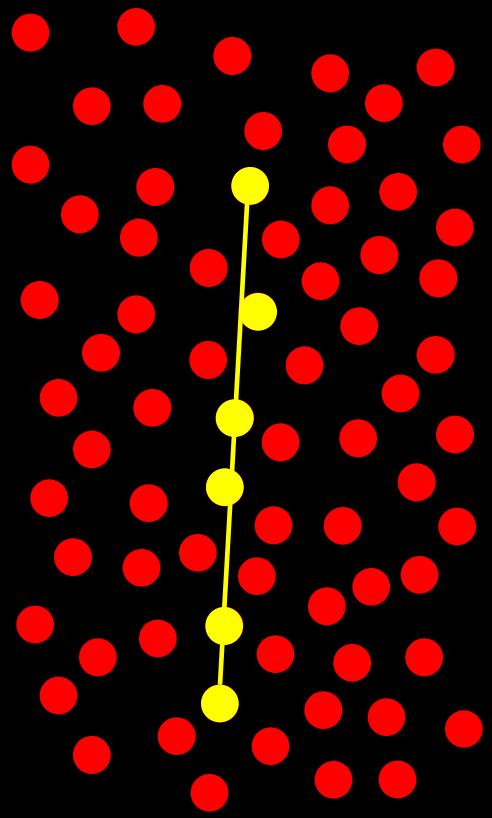


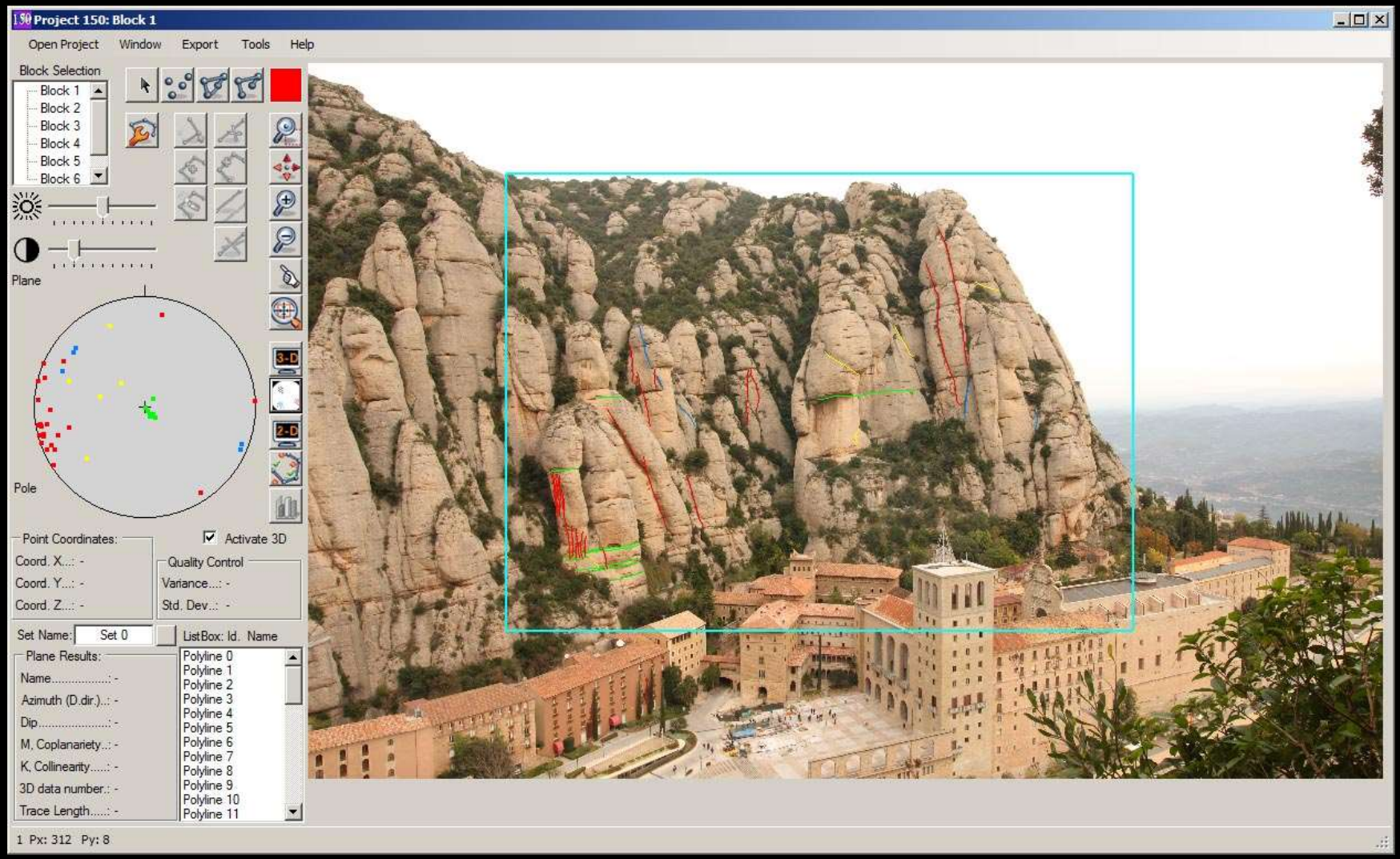
Image coordinate X_i, Y_i

Model Coordinate: X_m, Y_m, Z_m

Selected points respect to line distance tolerance in order to model density

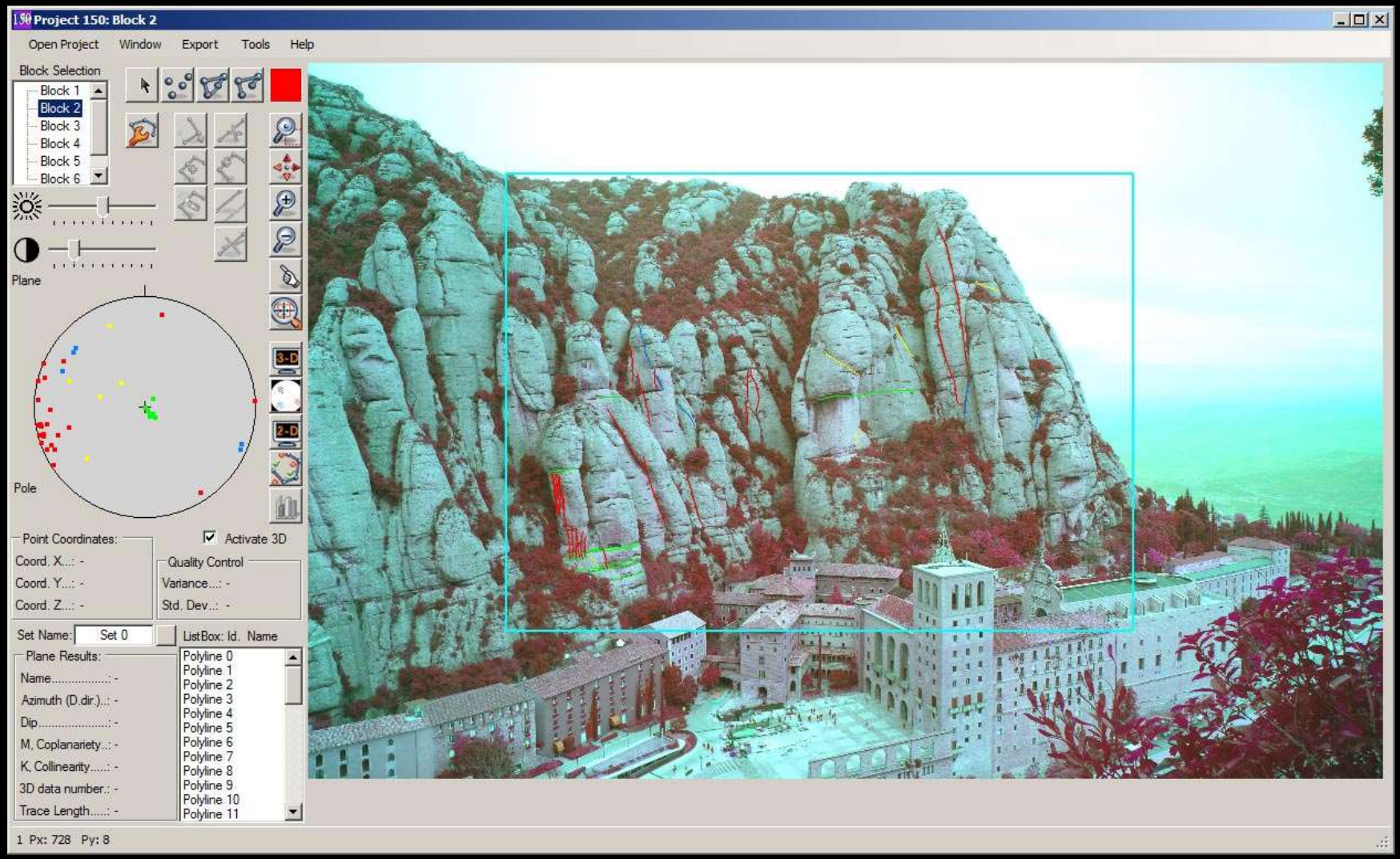
Cotiella Massif, Pyrenees. Cenomanian limestones

Data extraction from lineations: Image advantages



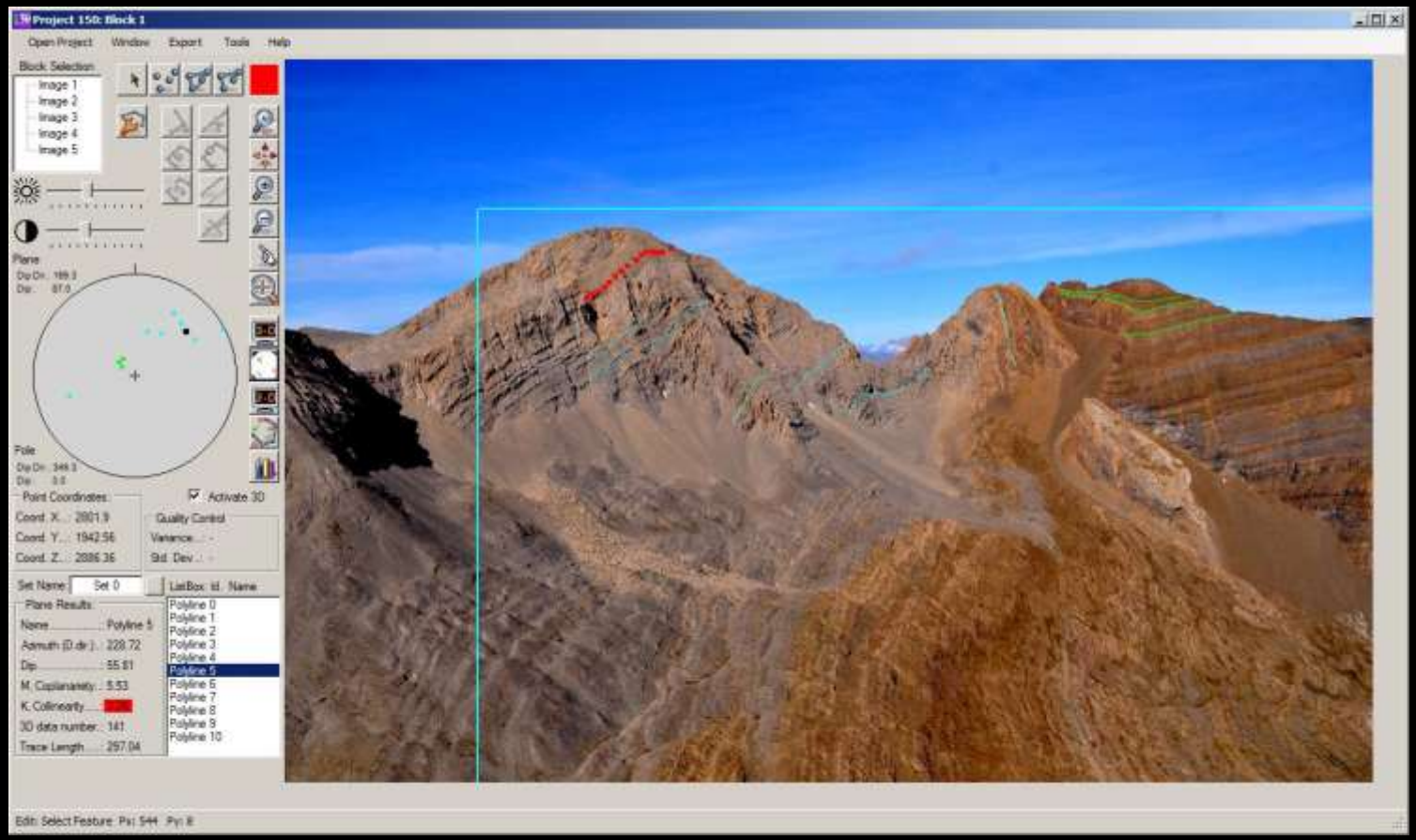
Cotiella Massif, Pyrenees. Cenomanian limestones

Data extraction from lineations: IR image



Cotiella Massif, Pyrenees. Cenomanian limestones

Data extraction from lineations: Photogrammetric solutions, orthoimages



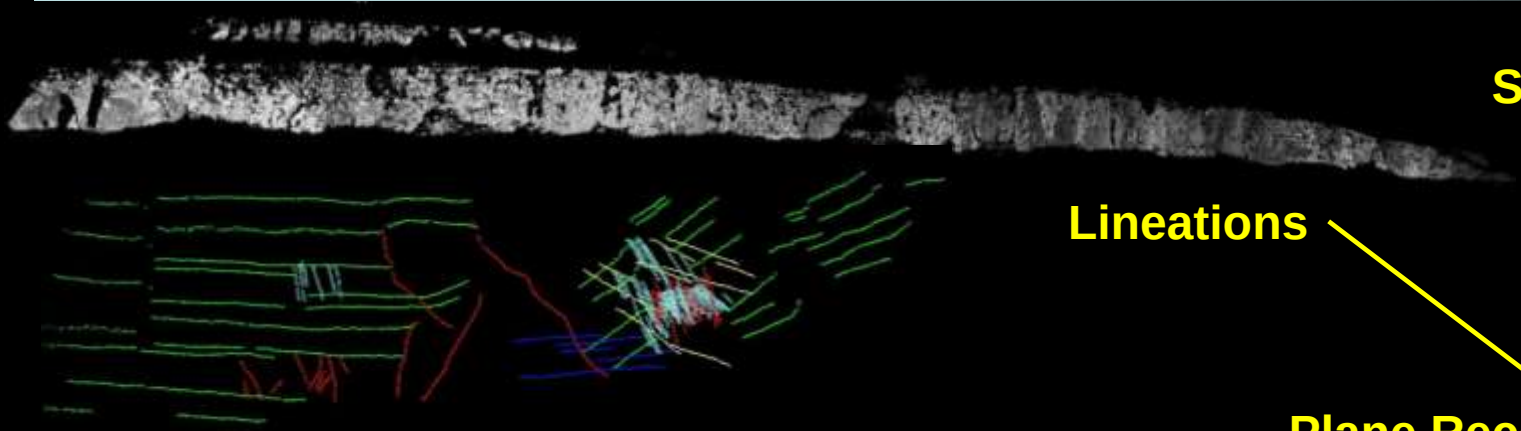
Digitalization at field, before acquisition

or at desktop, after processing High Density Model

Cotiella Massif, Pyrenees. Cenomanian limestones

Analysis

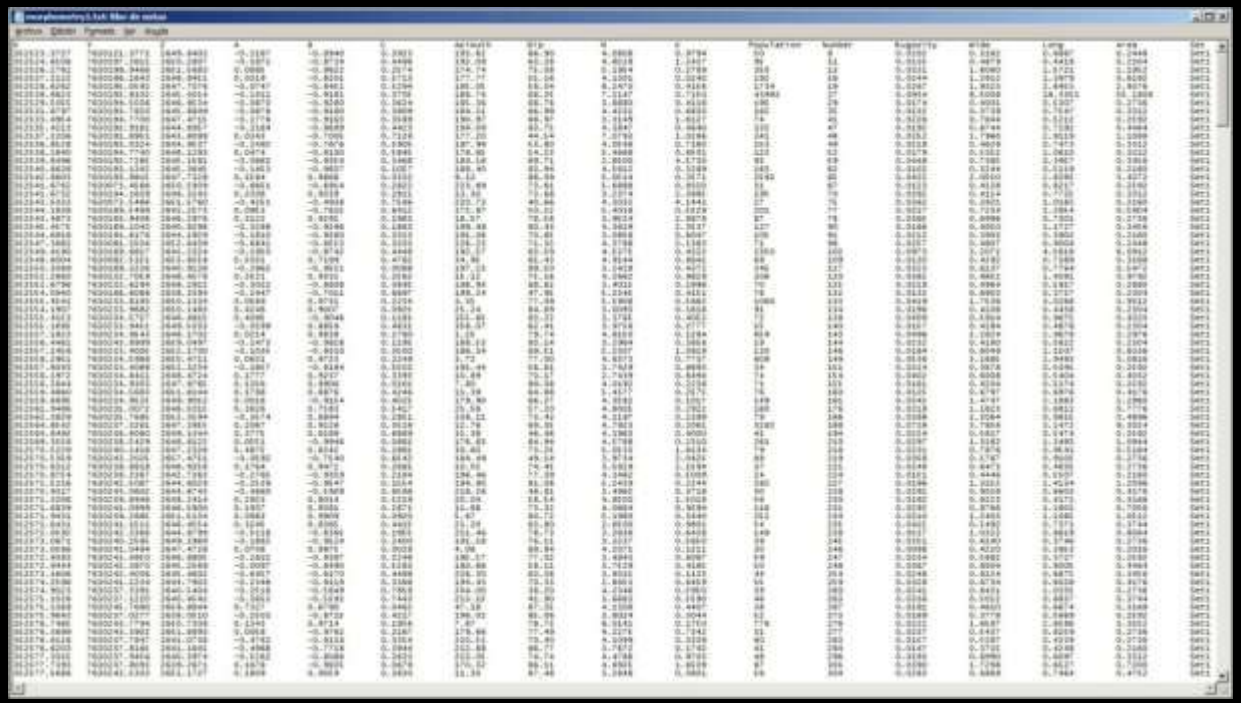
Surface Detection: Isolate patches-Reconstruct surfaces



Surfaces

Lineations

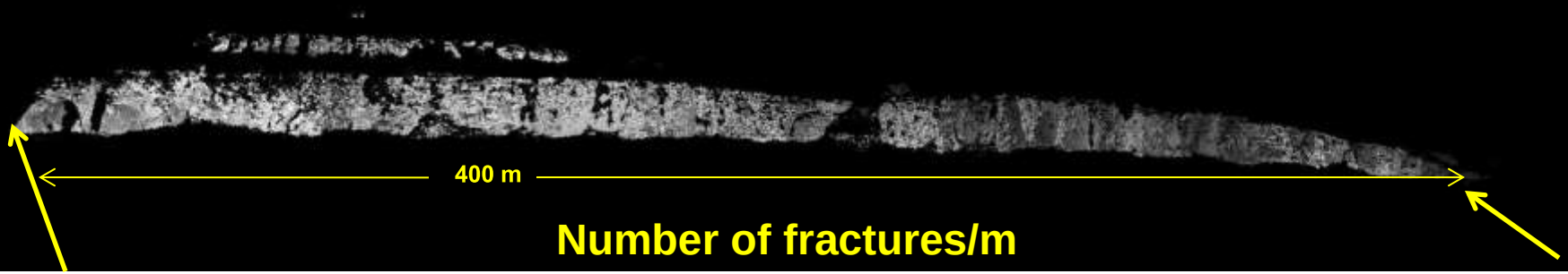
Plane Reconstruction



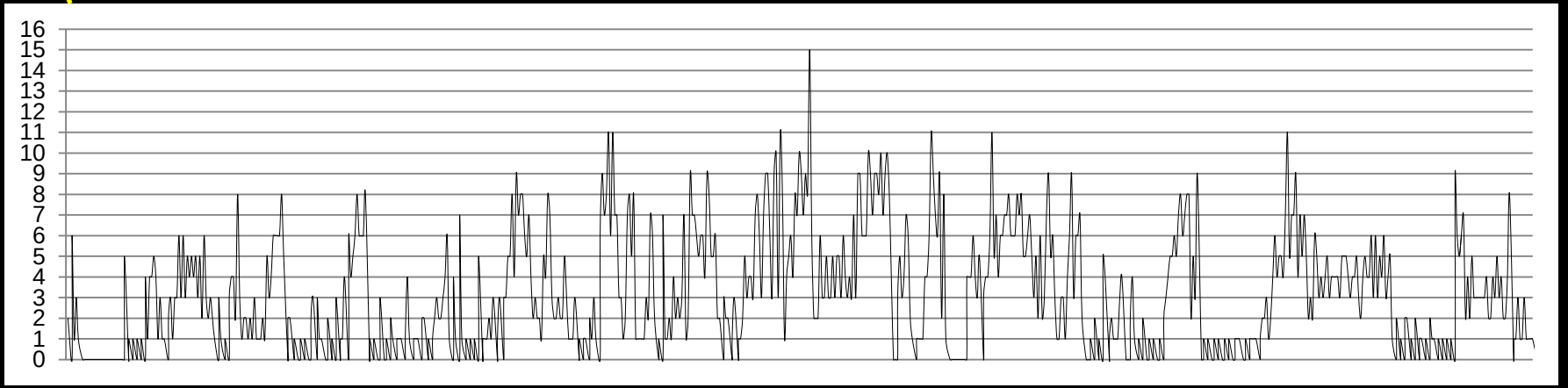
Morphological Model

- Centroid
- Plane Orientation
- Points used
- Rughness
- Approachs in
  - Wide
  - Long
  - Area

Analysis: Morphological model for analysis



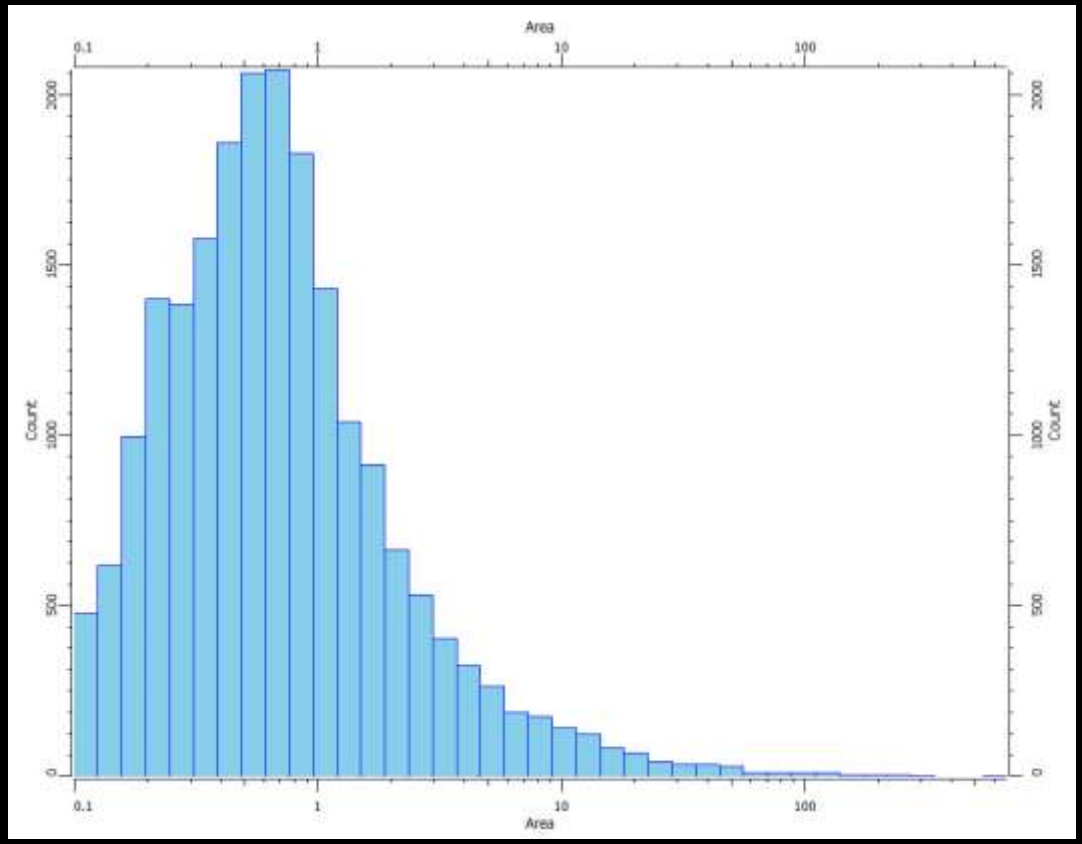
Number of fractures/m



Scanline data:

- Number of fractures/m
- Spacing Mean
- Number of fractures / Scanline
- Density of fractures
- Orientation Mean
- Frequency: Area, spacing....

Analysis: Morphological model



Histograma of logarithmic base for plane area and set