



transforming the way the world works



Technology Update

“What’s the point(s)?!”

What's the point(s)?!

- **Total Stations becoming scanners**
- **Surveyors taking to the air**
- **Surveyors taking to the road**
- **What next....?**



transforming the way the world works

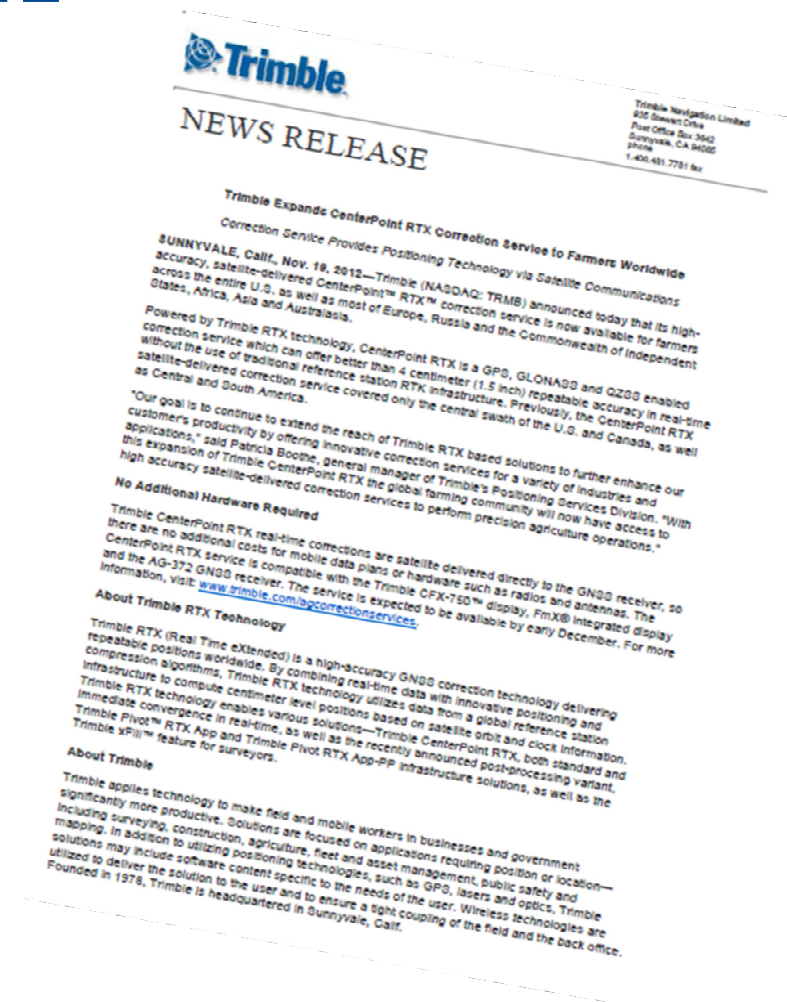
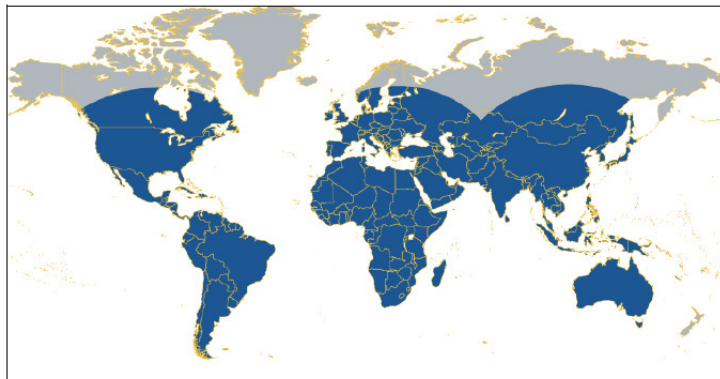


“Centimeters everywhere”

Latest in GNSS Corrections

Launched 19 November 2012

- Trimble CentrePoint RTX
 - Near ‘Global’ correction service



Development in GNSS Receivers

Trimble R10

Features

- Smallest and lightest receiver in its class
- Cutting edge Trimble HD-GNSS processing engine
- Automatic point measurement and traceable tilt values
- Electronic bubble so you can focus in one place
- Trimble xFill™ technology provides RTK coverage during connection outages
- Powerful 440 channel solution with Trimble 360 technology advanced satellite tracking
- Pair with Trimble Access and the TSC3 controller for the most powerful solution on the market
- Now subscribe to Trimble CentrePoint RTX for cm positioning without the need for a network or base station





transforming the way the world works



Trimble V10 Imaging Rover

“A picture says a thousand words”
(or a thousand points...)

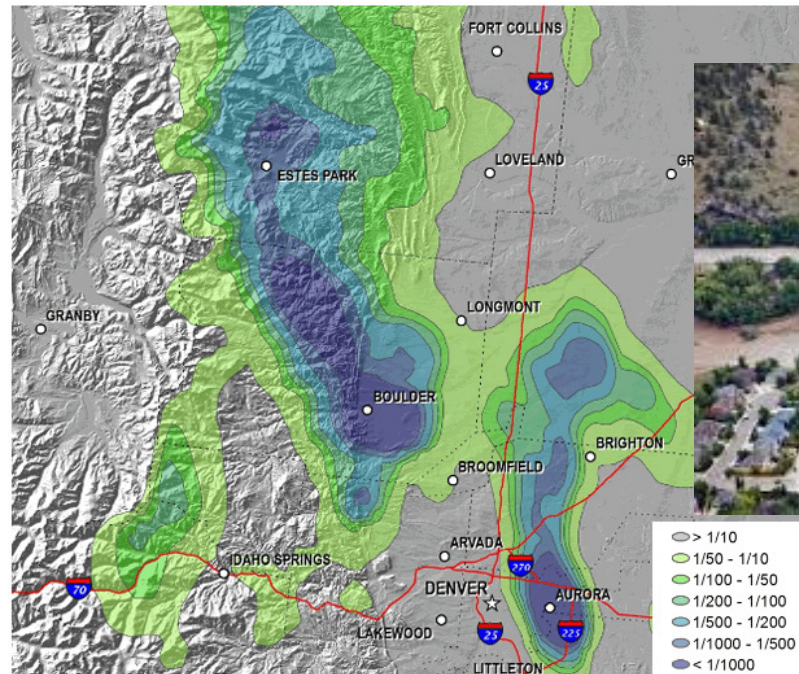
Colorado Floods

Colorado's exceedingly rare flood in 3 maps

By Jason Samenow, Published: September 19 at 1:56 pm [E-mail the writer](#)

New visuals from the National Oceanic and Atmospheric Administration reveal the exceptional nature of rainfall that flooded parts of 17 counties in Colorado last week.

The map below – as an example – shows the likelihood of the maximum 24-hour rainfall totals (in any given year) that occurred along the Colorado Front Range between September 9 and 16.



Annual exceedance probabilities for the worst case 24-hour rainfall. (NOAA)

Rain slows rescue efforts amid deadly Colorado floods

Join the conversation [By David Simpson, Nick Valencia and Emma Lacey-Bordeaux, CNN](#)
[CNN iReport](#) updated 12:33 AM EDT, Mon September 16, 2013



Railroad tracks washed from their path by floodwaters are seen in Longmont on Thursday, September 12. Massive flooding has left people dead and thousands of homes state.

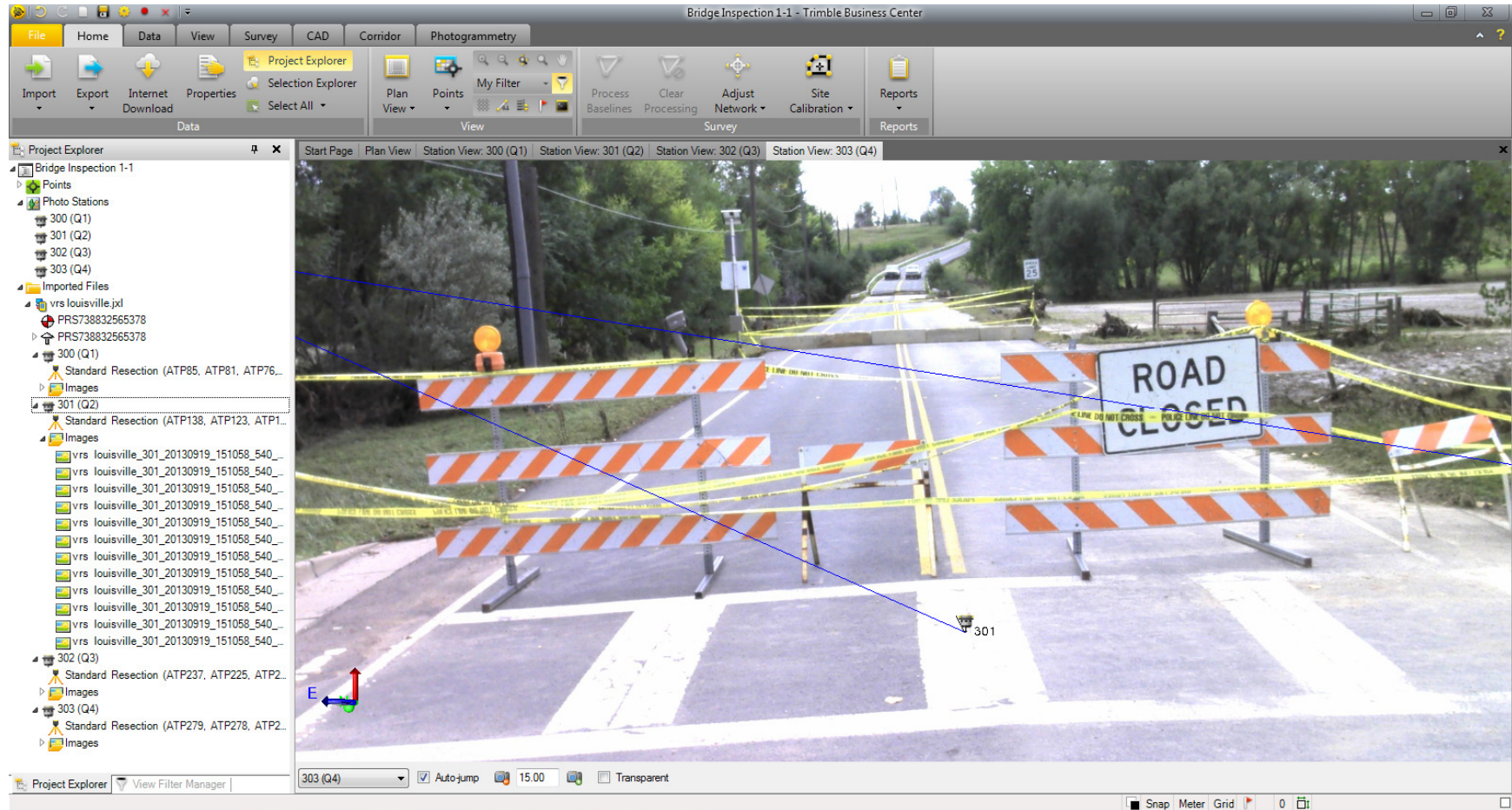
HIDE CAPTION

17 18 19 20 > >>



Emergency Management





Trimble V10 Imaging Rover



Trimble V10 Imaging Rover

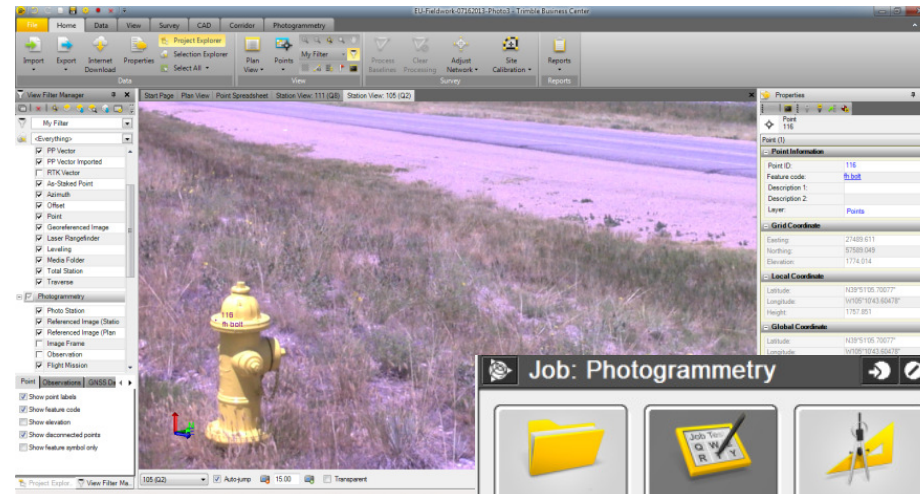
The Trimble V10 Imaging Rover is an integrated camera system that precisely captures 360° digital panoramas used to visually document and measure the surrounding environment.



Trimble V10 – *Positions from Pictures*

System Overview

- Position sensor
- Camera system
- Power rod
- Tablet
- Field software
- Office software



Positioning Sensor

- Integrates seamlessly with R10 GNSS receiver and S-Series total station positioning sensors.
- Panoramas may also be captured standalone pre- or post- survey of occupied points



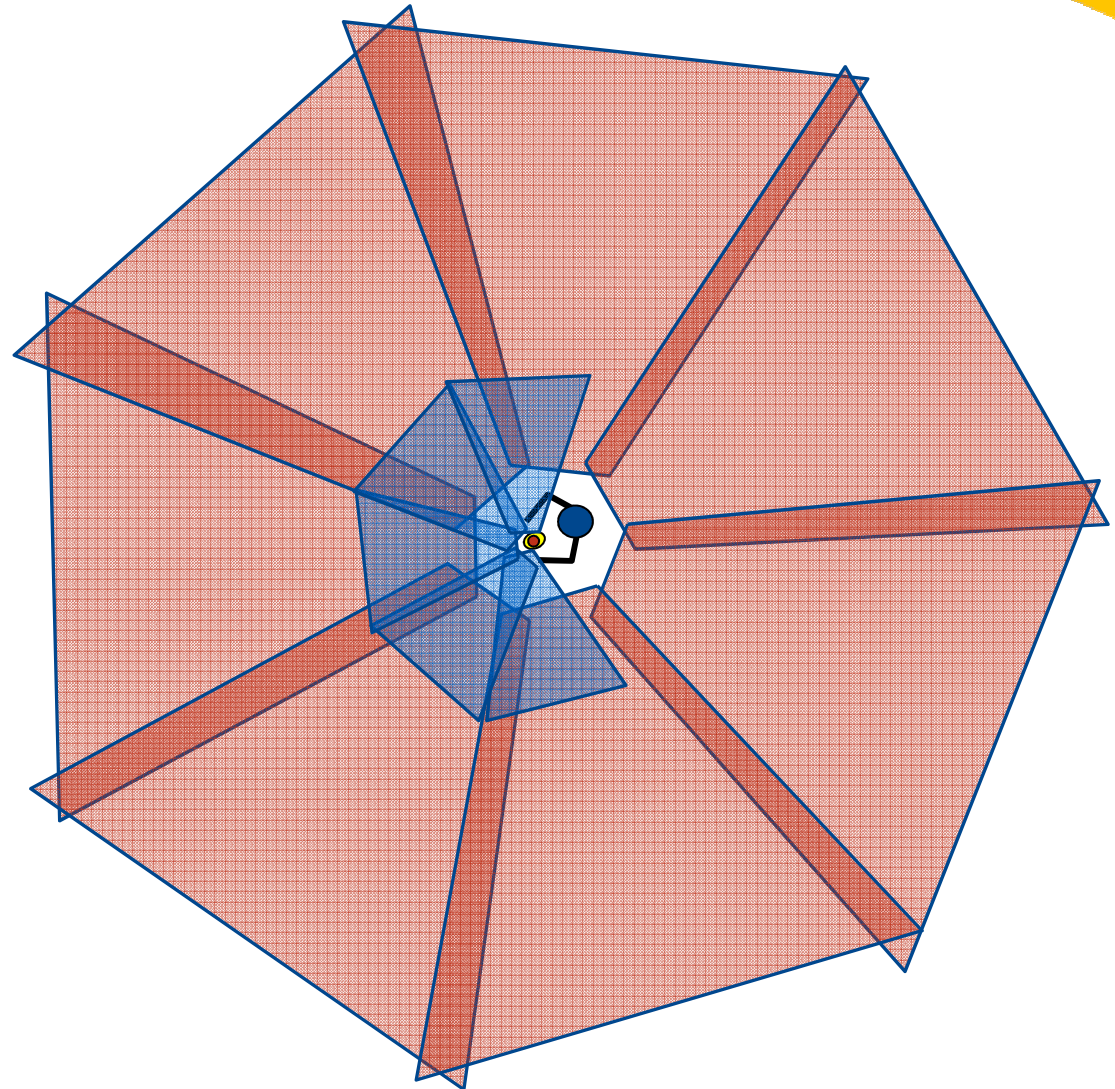
Camera System

- 12 calibrated cameras
- 60 Megapixel 360° panorama
- Sequential image capture
- Tilt sensors
- Magnetic compass
- Gyrometers and accelerometers
- On-board data storage
- USB communications
- 2m pole drop tested
- IP 54 environmentally protected

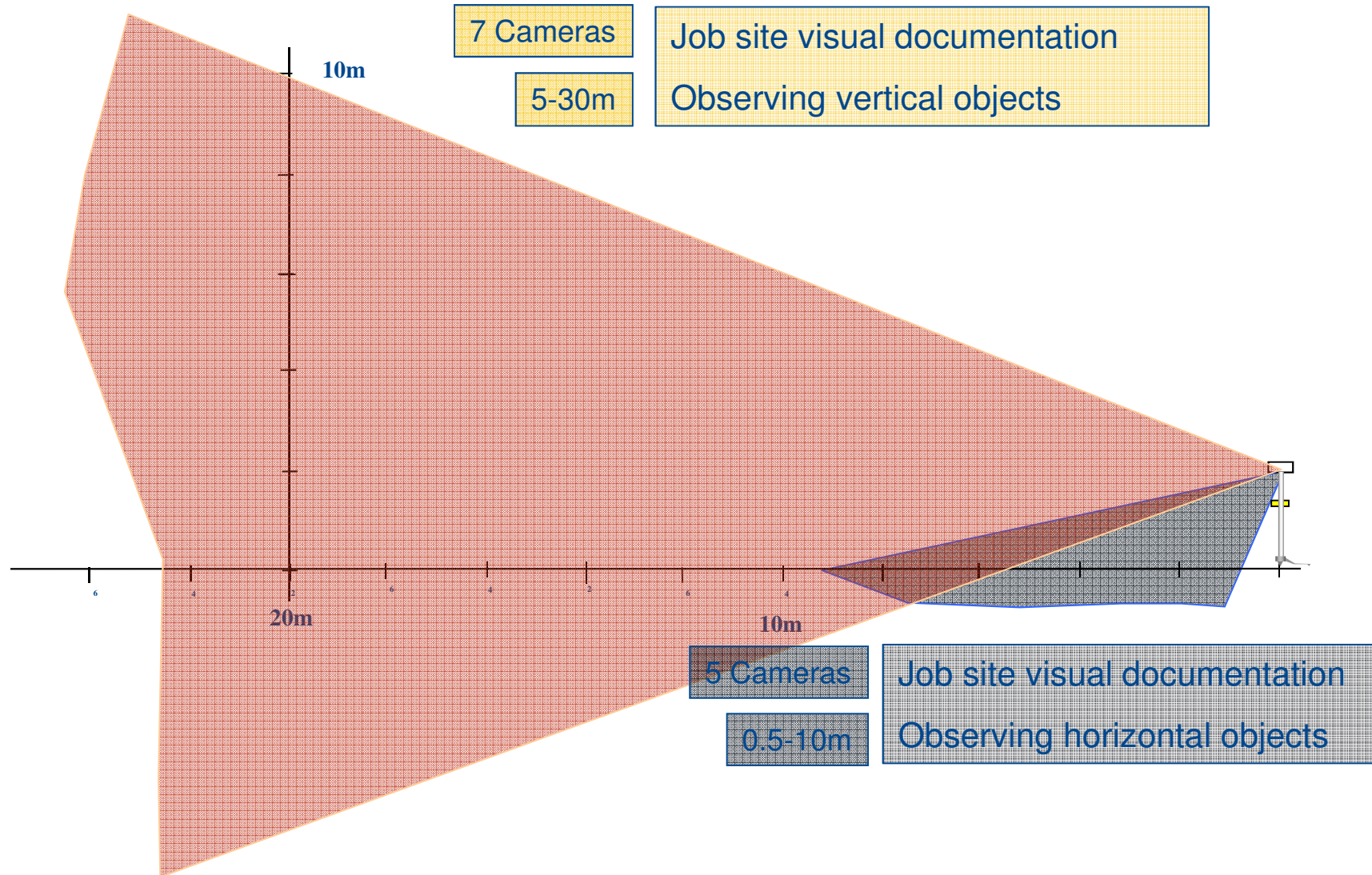


Camera System

- 7 panoramic cameras
- 5 downward-looking cameras



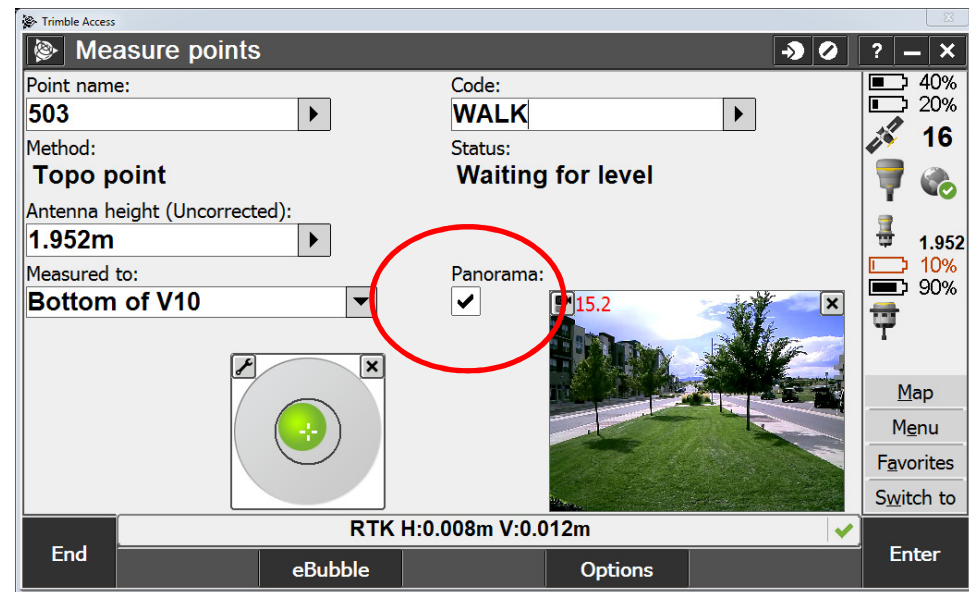
Camera System



Field Software



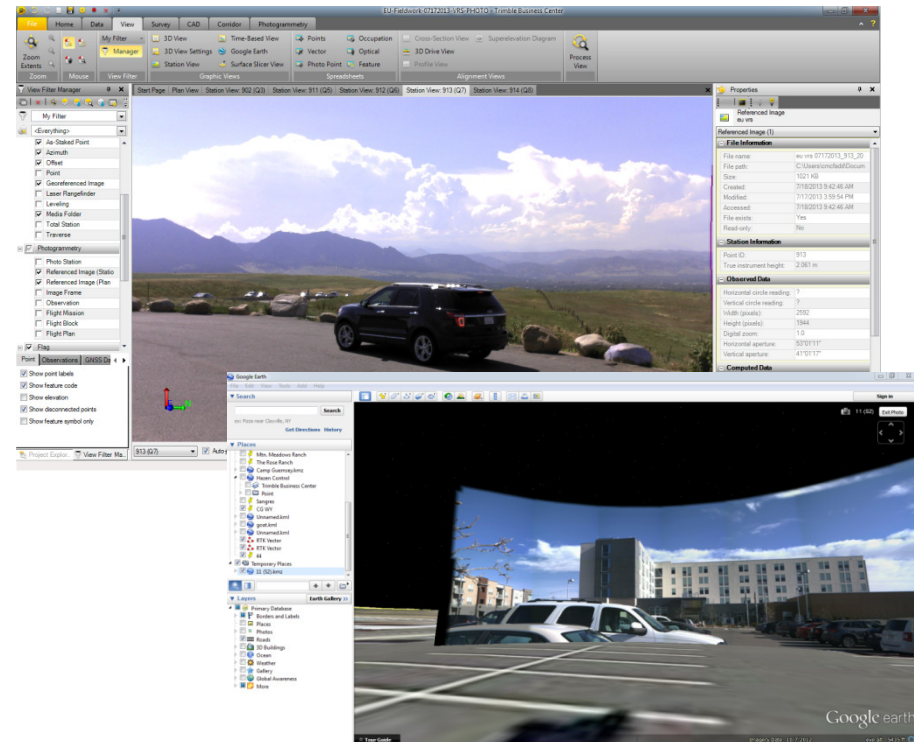
1. Streaming video
2. Capture and store panoramas simultaneously with points or standalone
3. Review thumb-nail images
4. Review Panoramas



Office Software



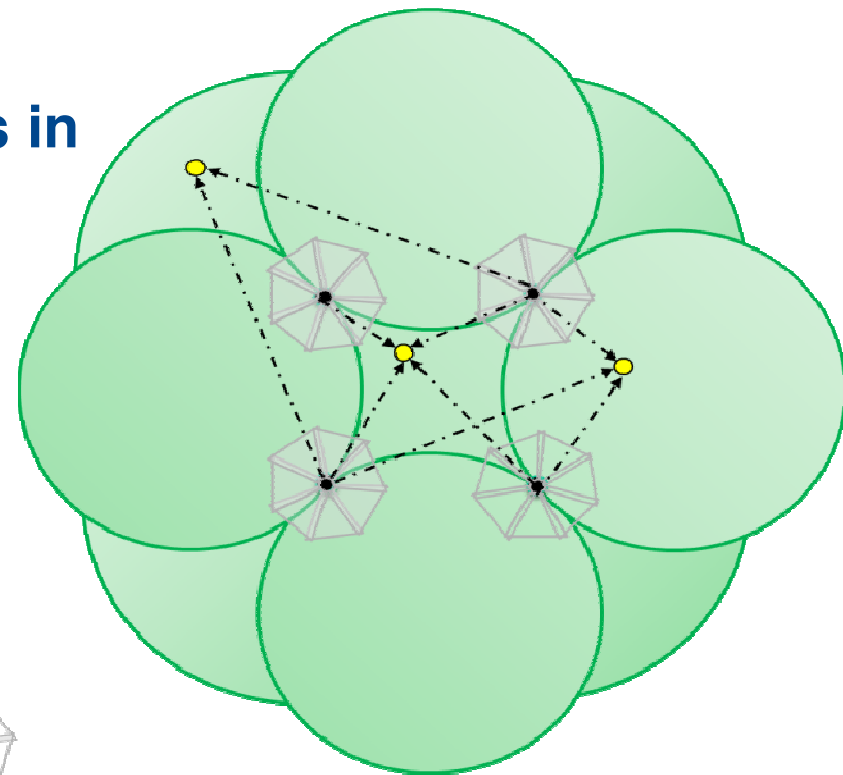
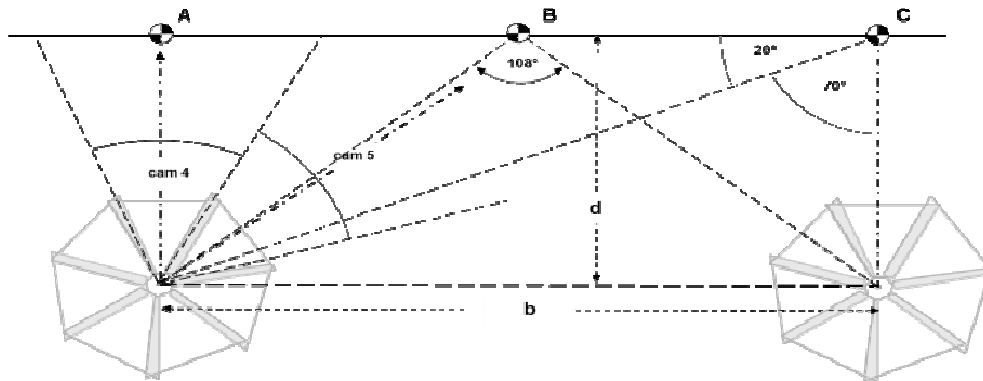
1. Network adjustment of panoramas
2. Measure photo points
3. Panoramic review with data overlay
4. Export panoramas (jpeg, html, kmz)
5. Export deliverables (CAD, GIS)



How Does It Work?

How do I get Positions from Pictures?

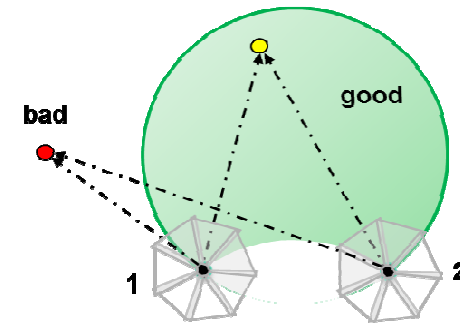
- Capture panoramas in the field using Trimble Access
- Process the data in Trimble Business Center
- Measure objects in the photos in TBC to create positions
- Prepare deliverables in TBC from the positions



How Accurate is it?

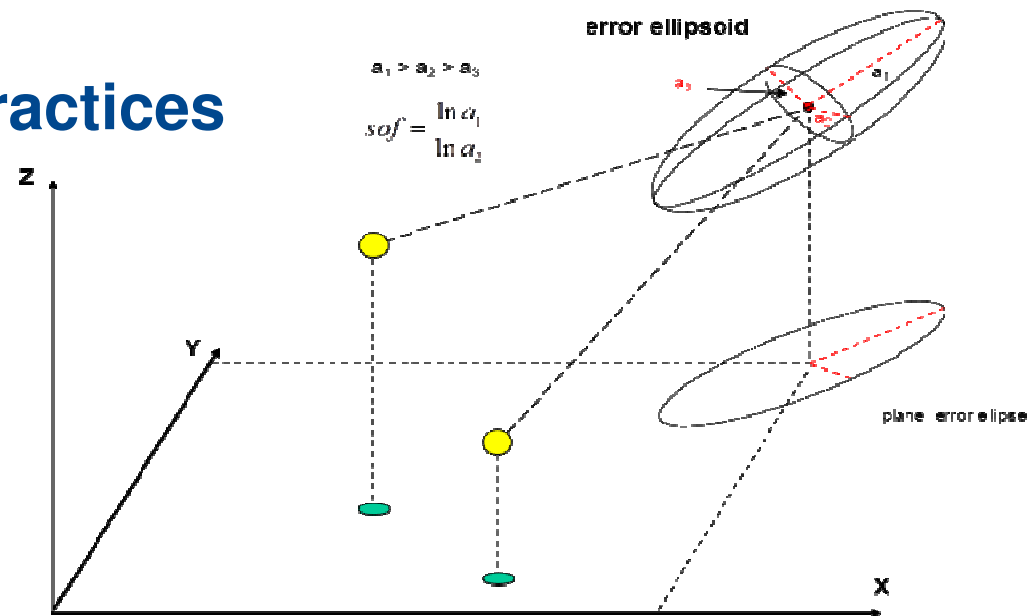
How accurate are the positions produced by the system?

- **1 Centimeter sample distance @ 10 meters from object with good network geometry (2cm @ 20m, 3cm @ 30m)**



- **Dependent of field practices**

- Distance to object of interest
- Distance between stations
- Site geometry



Old Survey Workflow

Capture points in the field

Download CSV file

Import to CAD

Connect the dots

Publish 2D+ Paper

A	B	C	D	E
1	Jobtrfd topo	Version:12.40		
2	JEFFCO AZ MK	36795.216	948994.155	1680.26 disk
3	RESET	369123.462	948831.23	1694.016 disk
4	rtid	369151.988	948910.316	1692.218 nail
5	700	369173.234	948993.425	1688.387 nail
6	701	369356.363	949005.57	1686.323 nail
7	702	369106.877	948895.396	1689.728 epmt
8	703	369106.917	948896.102	1689.732 epmt
9	704	369119.592	948895.05	1689.988 epmt
10	705	369119.699	948896.101	1689.932 cmh
11	706	369141.697	948893.316	1690.259 epmt
12	707	369149.048	948893.194	1690.268 epmt
13	708	369149.063	948895.975	1690.203 lp
14	709	369146.909	948894.306	1690.209 sp
15	710	369155.376	948893.92	1690.274 epmt
16	711	369162.194	948896.931	1690.165 epmt
17	712	369164.646	948900.184	1690.102 epmt
18	713	369166.73	948900.841	1690.06 epmt
19	714	369155.277	948894.238	1690.178 rb
20	715	369160.339	948896.202	1690.1 rb
21	716	369163.519	948898.879	1690.095 rb
22	717	369166.873	948905.379	1689.89 rb
23	718	369167.475	948905.338	1689.996 epmt
24	719	369166.587	948906.736	1690.005 sp
25	720	369167.955	948911.792	1689.791 epmt
26	721	369168.318	948923.306	1689.646 rb
27	722	369169.165	948923.289	1689.649 epmt
28	723	369171.634	948949.88	1689.204 epmt
29	724	369170.482	948946.445	1689.238 rb
30	725	369169.771	948949.92	1689.273 rb

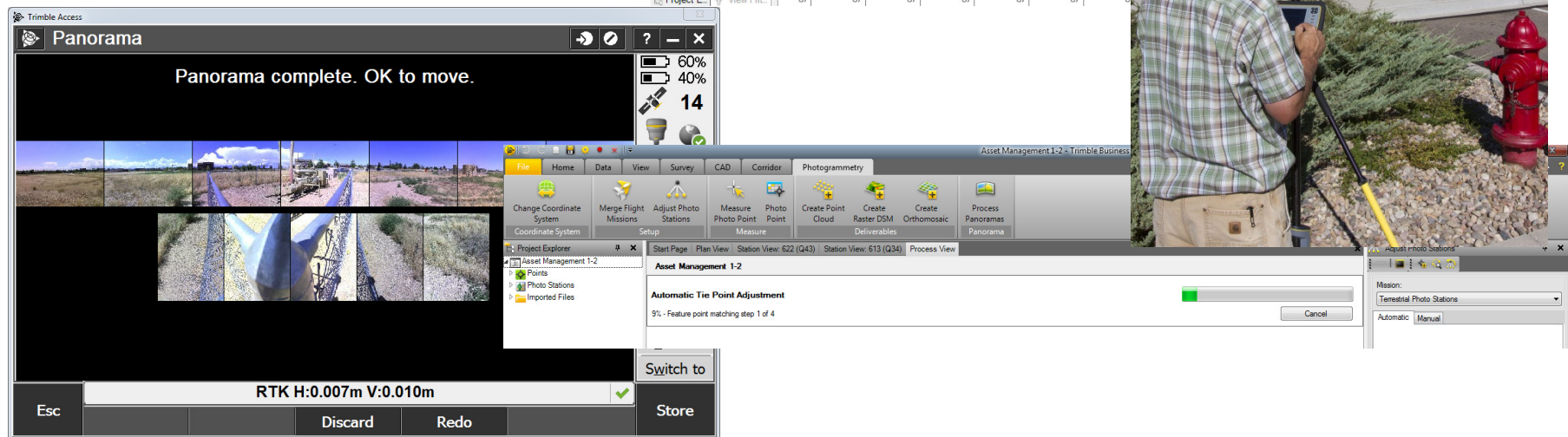
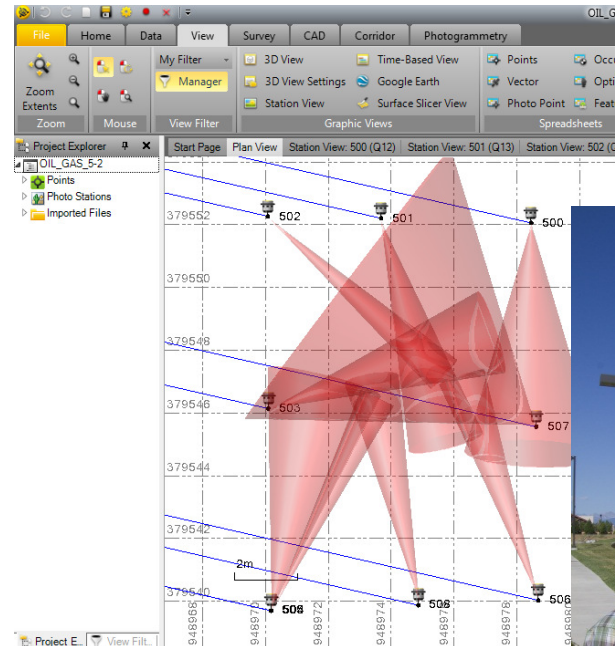


8/6/12 6011 DIA DAT WEST & SOUTH
 BASE @ 788 HI = 605
 CHECK # 5413 STORED @ 6010

STORE	DESC
6011 → 6080	GND
100971 → 100974	ECC 2
100975 → 100976	SIGN
100977 → 100978	E ELECTRIC CAN
100979 → 100980	SIGN
100981 → 100984	ECC
100985 → 100999 (N)	RIM LIGHT
101000	(W) RIM LIGHT CUMMULE TO SHOOT N RIM
101001-101010	E LIGHT (RUNWAY/FLUSH)
101011-101019	RIM (N) LIGHTS
101020-101175	E LIGHTS (RUNWAY/FLUSH)
101176-101190	RIM (N) LIGHTS
101191	RIM (W) LIGHTS
101192-101284	RIM (N) LIGHTS (END OF RUNWAY)
101285-101289	GND
101290-101299	GB
101300-101303	COR INLET
101304	E INLET (924 BOTTOM OF BOX)
101308-101323	GB 2
101323-101344	GB 3
101356-101367	WAL (TOP EDGE HEADWALL)
101368	PIPE 30" RCP (N)
101369	CHK 5360

Trimble V10 Survey Workflow

- Mission planning
- Capture panoramas
- Process photo stations
- Measure objects in the photos
- Prepare new deliverables
- Reduce field time by ~30%





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Trimble UX5 Aerial Imaging Solution

“Point Clouds from below the clouds”

What is UAS?

- An unmanned aerial vehicle (UAV), commonly known as a drone, is an aircraft without a human pilot on board. Its flight is controlled either autonomously by computers in the vehicle, or under the remote control of a pilot on the ground or in another vehicle.
- The term **unmanned aircraft system (UAS)** emphasizes the importance of other elements beyond an aircraft itself. A typical UAS consists of the:
 - unmanned aircraft (UA)
 - control system, such as Ground Control Station (GCS)
 - control link, a specialized datalink
 - other related support equipment.

Benefits of Aerial Imaging Solutions

- Economic solution – enables aerial mapping technology, once reserved for the largest surveying & engineering firms, to be used by the masses
- Safety – enables surveying of rugged, hazardous, hard-to-reach or unhealthy areas without risking injury (or worse) to them or individuals in the area
- Efficient process – ability to collect and process data faster than often achievable with terrestrial-based survey technology
- Rapid workflow – system is designed to quickly plan a flight and collect data, allowing rapid response to your customer's needs (traditional photogrammetry processes)
- Versatile – a technology that can be used to serve numerous professional markets and applications

Typical Applications

	Boundary Surveys	Topographic Surveys	Site Planning	Route Planning	Progress Monitoring	As-Builts	Resource Mapping	Volume Calculation	Disaster Analysis	Vegetation Health
Engineering & Surveying	✓	✓			✓			✓		
Mining	✓	✓	✓	✓	✓	✓		✓		
Civil & Heavy Earthworks Construction	✓	✓	✓		✓					
Oil & Gas	✓	✓	✓	✓	✓	✓	✓	✓		
Environmental & Landfill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Public Agencies	✓	✓	✓	✓	✓		✓		✓	✓
Agriculture & Forestry	✓		✓		✓		✓		✓	✓

Topographic Survey



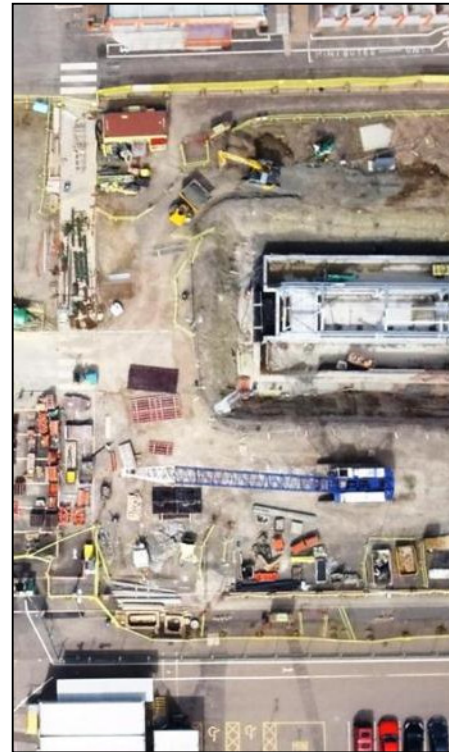
Switzerland
510 Images
400 m Flight Height
11 cm GSD
3.12 km²

Route Planning

Belgium
462 Images
150 m Flight Height
5 cm GSD
0.8 km²



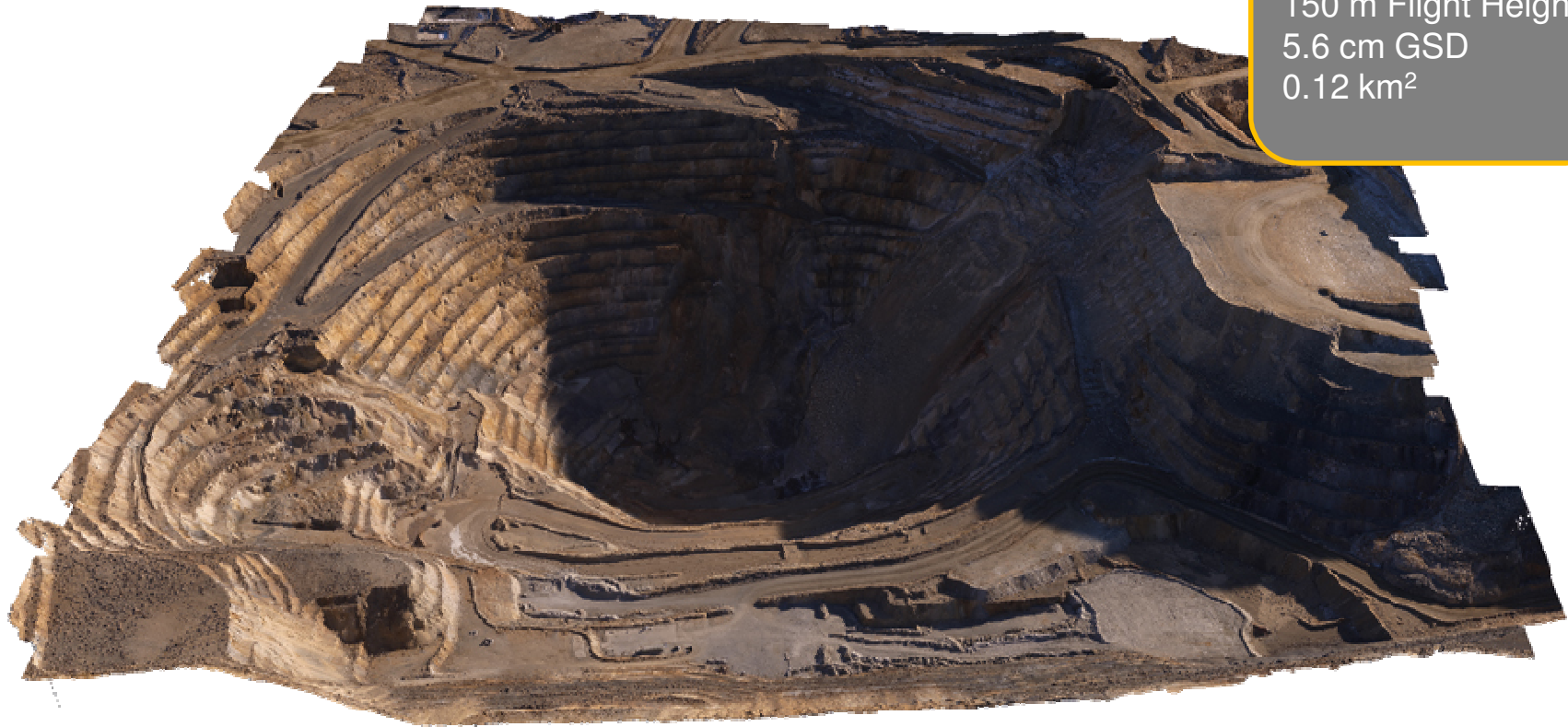
Progress Monitoring Example



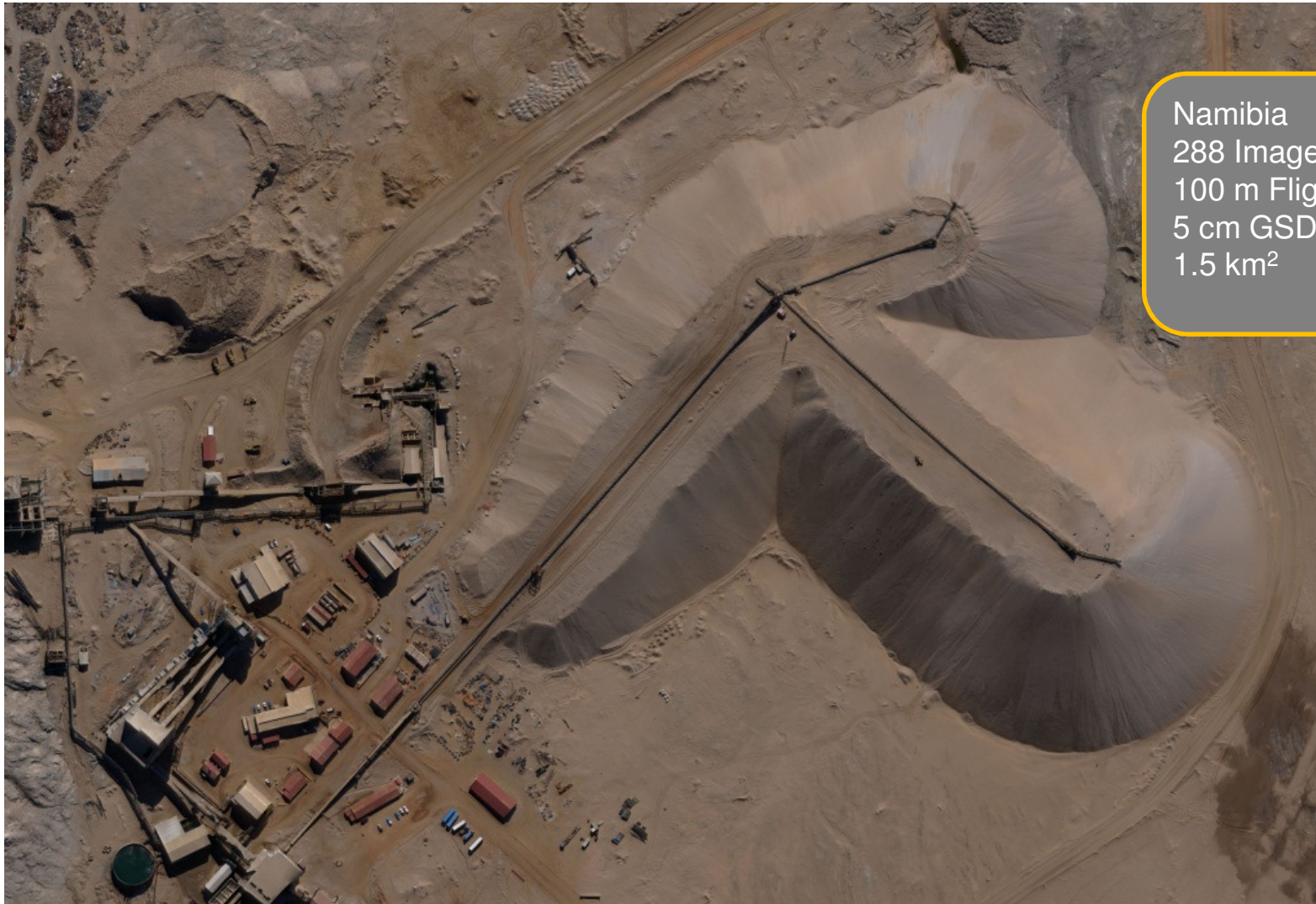
United Kingdom
150 m Flight Height
5.7 cm GSD
2.4 km²

Volume Calculation Example

Open Pit Mine
641 Images
150 m Flight Height
5.6 cm GSD
0.12 km²



Resource Mapping Example

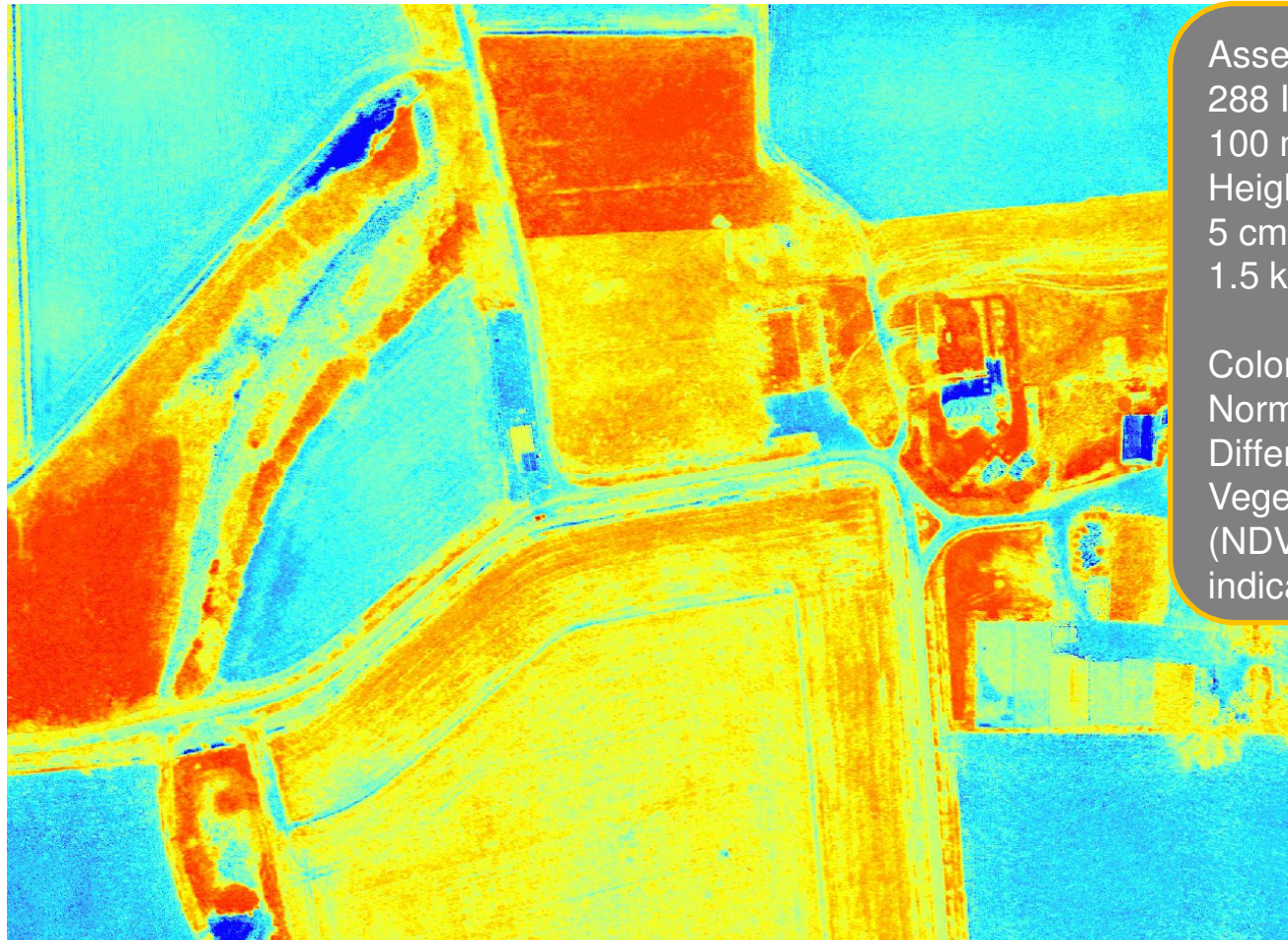


Namibia
288 Images
100 m Flight Height
5 cm GSD
1.5 km²

Disaster Analysis Example

- Strange how no one will give us permission to use their disaster as an example in our presentation

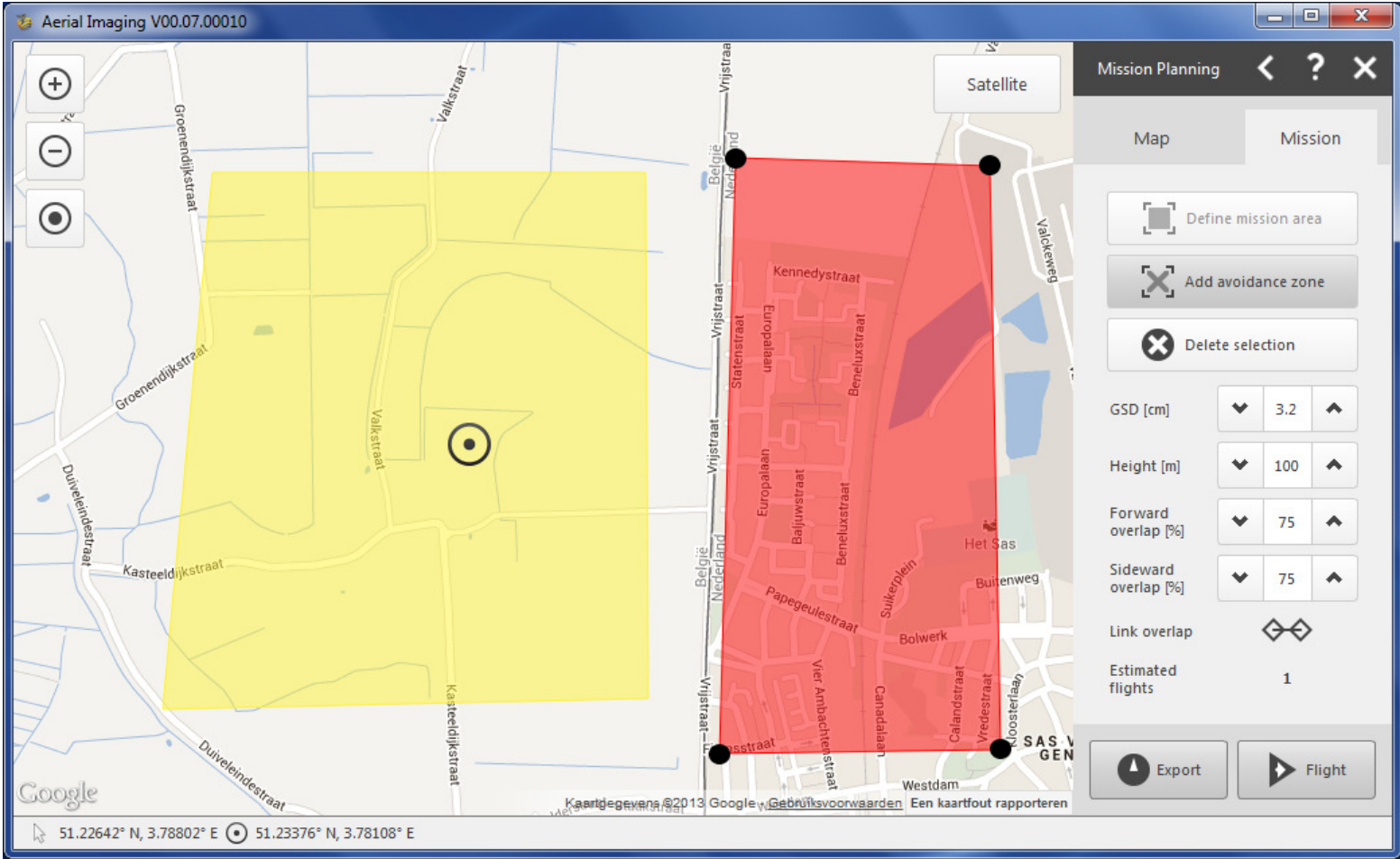
Vegetation Health Example



Assenede
288 Images
100 m Flight
Height
5 cm GSD
1.5 km²

Color relates to
Normalized
Difference
Vegetation Index
(NDVI) value -
indication of health

Defining the Project Area



Defining the Flight

Aerial Imaging V00.07.00010

Flight Planning

Area	Parameters
Duration	34 min
Size	1.30 km ²
Length	1,087 m
Width	1,195 m
Forward overlap	75 %
Sideward overlap	75 %
GSD [cm]	4.8
Height [m]	150

Flight 1

Google
Kaartgegevens ©2013 Google - Gebruiksvoorwaarden Een kaartfout rapporteren

51.22642° N, 3.77605° E 51.23376° N, 3.78108° E

Flight Operation

The screenshot displays the Aerial Imaging V00.07.00010 software interface. The main window shows a Google Maps satellite view of a city area with a planned flight path. The path consists of a series of orange diamond-shaped waypoints connected by lines, forming a grid-like pattern over a blue-shaded area. A black aircraft icon is positioned on the path, and a red-shaded area is visible on the right side of the map.

On the right side of the interface, there is a 'Flight - Scanning' panel with the following data:

COM	GPS	BAT
0	0	14

Below the data is a throttle control slider with markings at 10, 0, -10, and -20. Further down, the following flight parameters are listed:

Height	150 m	Desired	150 m
Airspeed	75 km/h	Desired	75 km/h
Throttle	16%		
Time	00:30	Battery	06:38

At the bottom of the interface, there are several control buttons: Land, Fly to, Hold, Home, Right, and FTS. The status bar at the very bottom shows coordinates: 51.22617° N, 3.79077° E and 51.23376° N, 3.78108° E, along with an altitude of 51.23500° N, 3.78627° E and a ground speed of 75 km/h.

Trimble UX5 Aerial Imaging Rover

- Airframe
 - Internal carbon frame
 - Expanded polypropylene foam body
 - Engine & propeller
 - Servo-controlled elevons
- Payload Bay
 - Battery
 - Camera
 - Tracking beacon
- eBox
 - GPS & orientation sensors
 - 2.4 GHz radio
 - Autopilot



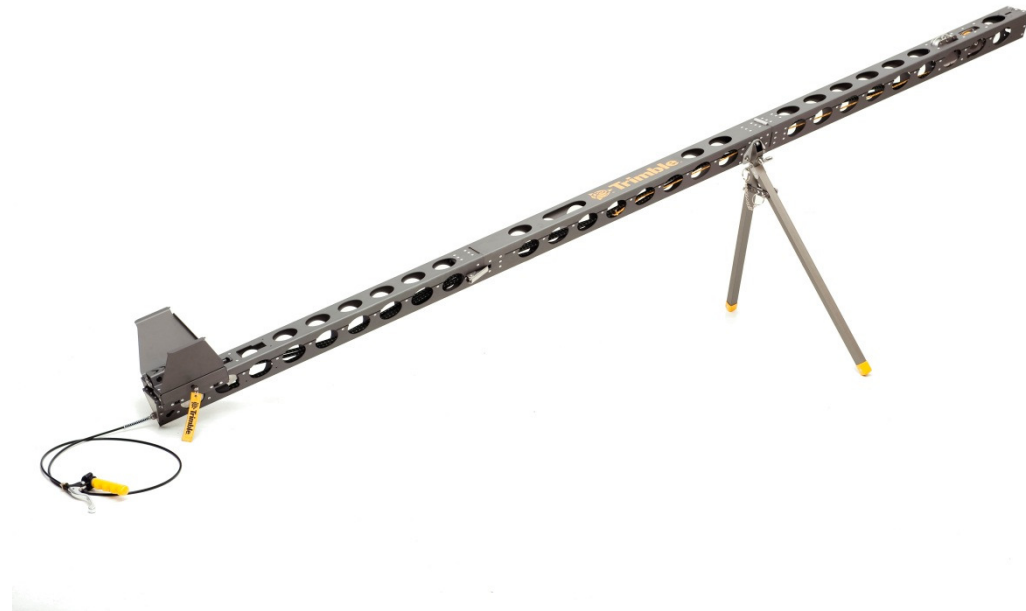
UX5 Camera



- Sony NEX5R digital camera
- 16.1 MP with APS-C sensor
- Fixed-optics Voigtlander lens
- Image size 4912 x 3261
- Standard color & Near Infra-Red versions
- Fixed lens increases the stability of the camera internal geometry

Launcher Components

- Ramp
 - Bungee
 - Winching tool
 - Release handle
 - Safety pin
- Launcher Dock
- Support



Ground Control

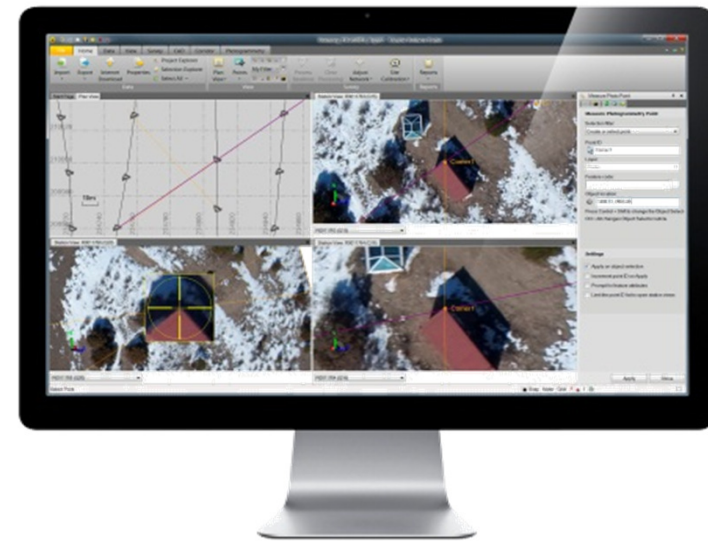
- Rugged Tablet
- Flight Planning & Control Software
- Communications Link
- Download Connector



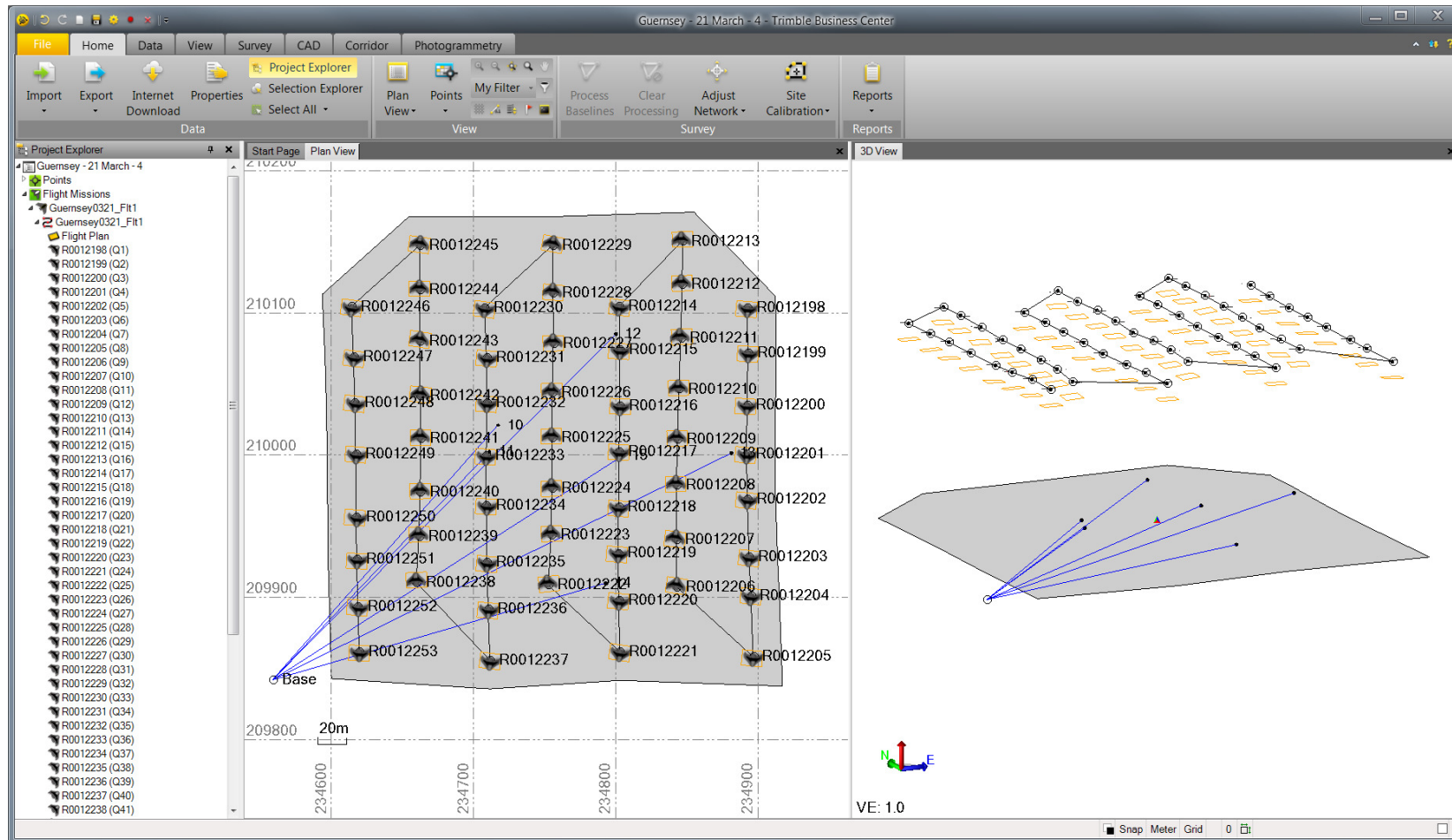
Trimble Business Center Photogrammetry Module



- Office application for processing traditional and Trimble UAS survey data
- 64-bit processor / operating system requirement
- Photogrammetry processing using technology from Inpho
- Simple workflows for importing flight data, stitching images, identifying ground control points, producing deliverables, and measuring features



Import Flight Data



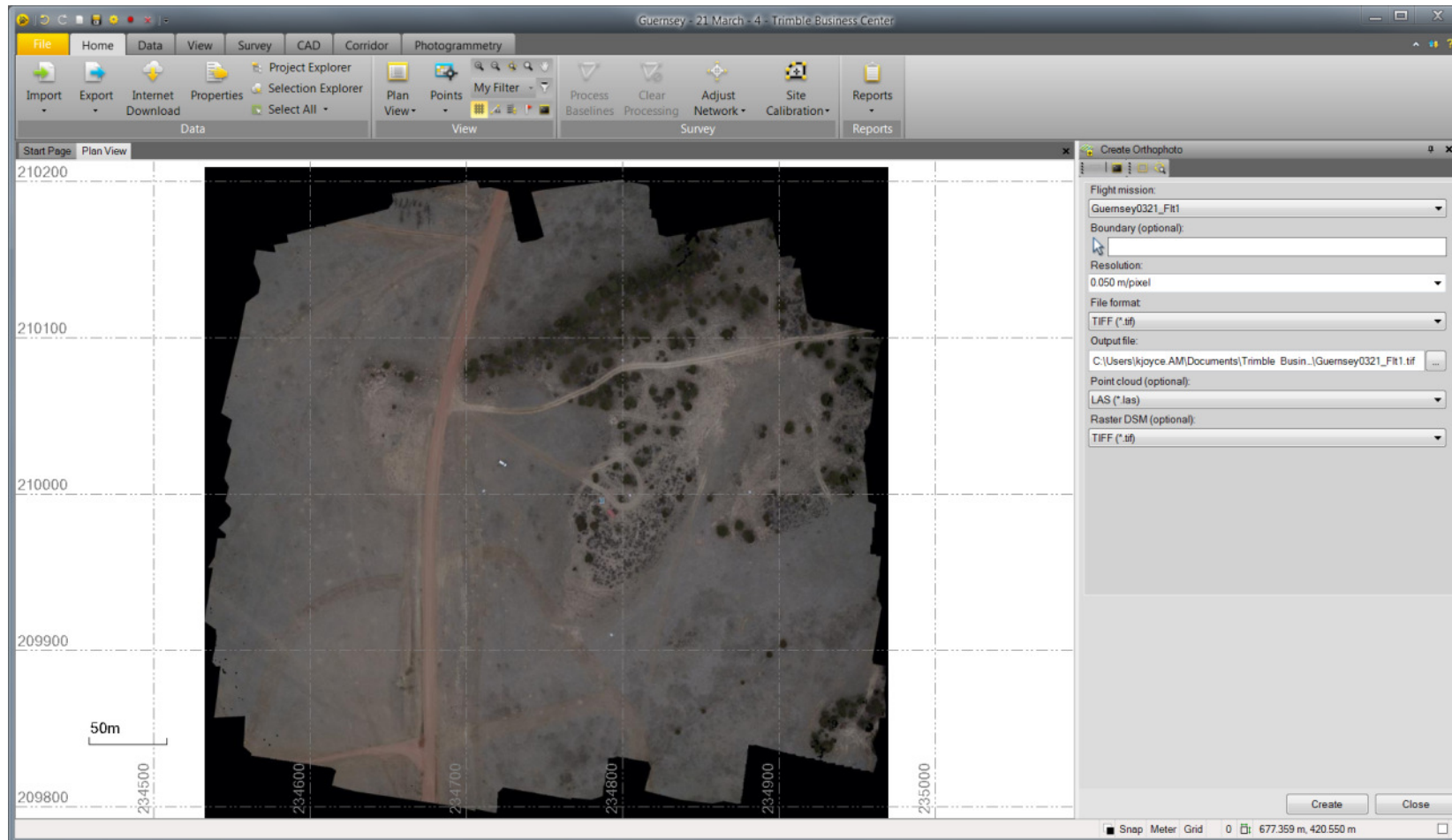
Identify Ground Control Points

The screenshot shows the Trimble Business Center software interface. The main window displays two aerial photos with ground control points marked. The left photo shows a point labeled '15' and the right photo shows a point labeled '5'. The 'Adjust Photo Stations' dialog box is open on the right, showing the 'Control Points' tab. The dialog box includes a table of control points and a list of photo stations seeing a selected point.

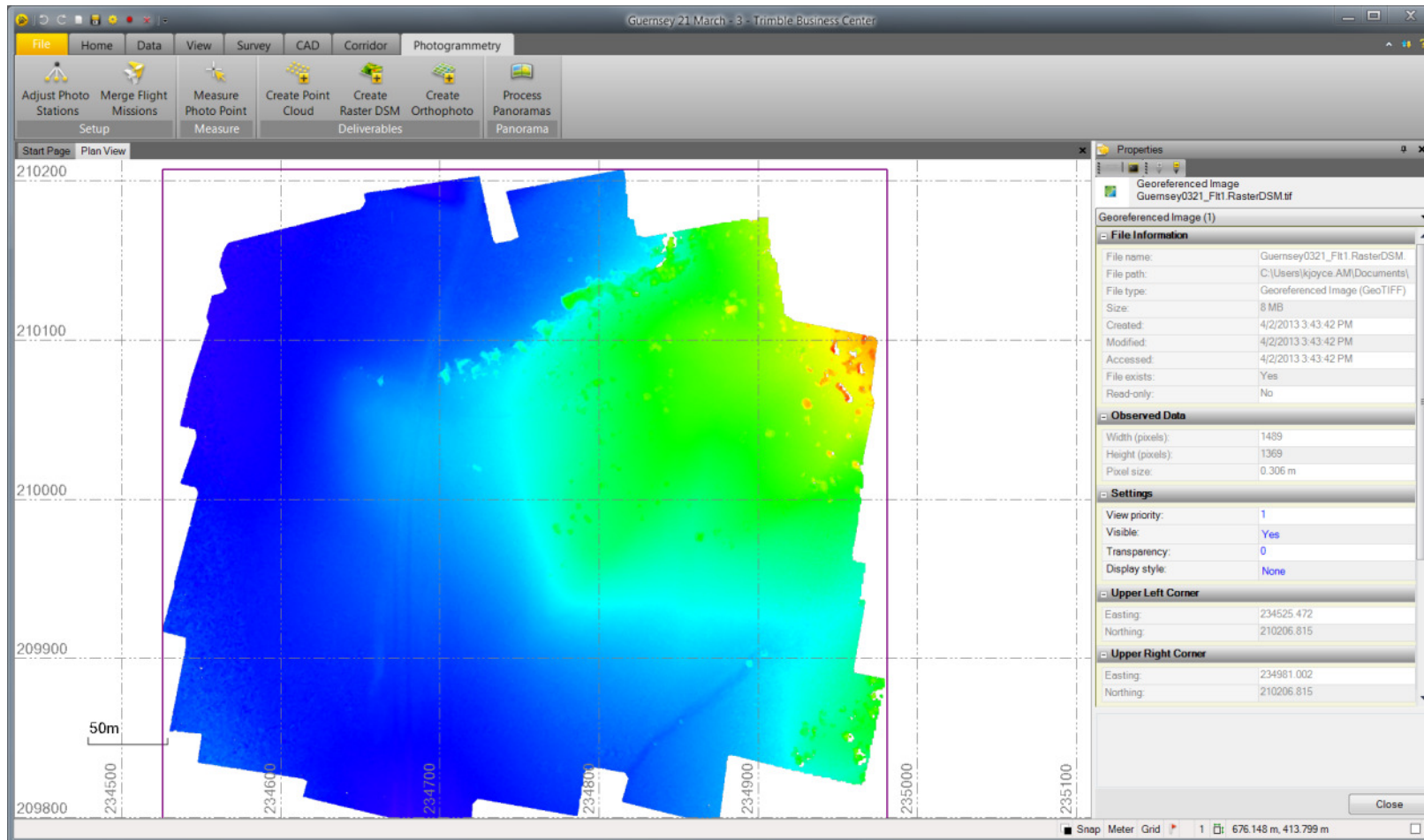
Point ID	Observations	Qu	Status
10	0	?	Enabled
11	5	?	Enabled
12	5	?	Enabled
13	5	?	Enabled
14	5	?	Enabled
15	5	?	Enabled

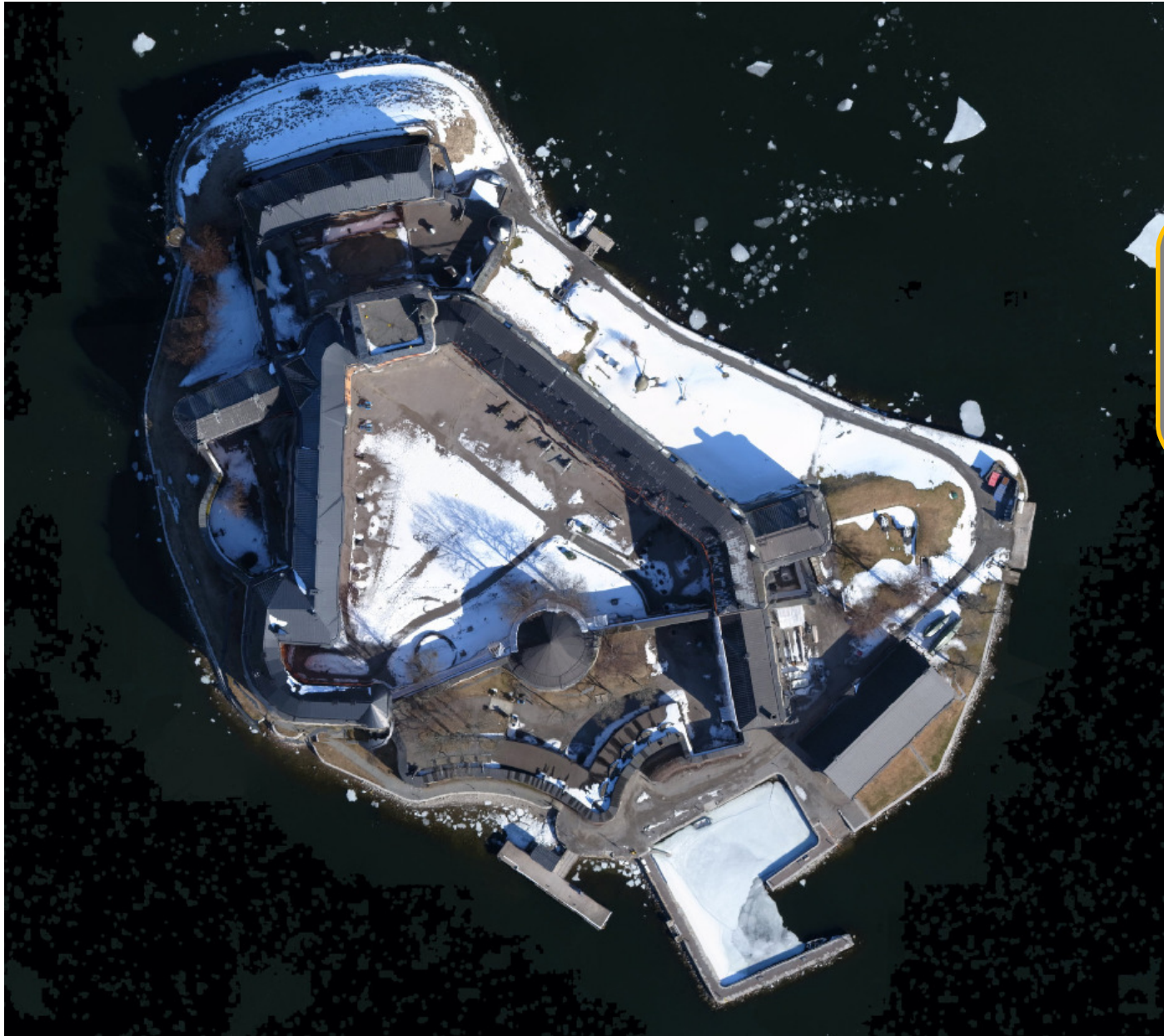
Photo Station ID	Status
R0012217 (Q20)	Enab... X
R0012216 (Q19)	Enab... X
R0012208 (Q11)	Enab... X
R0012209 (Q12)	Enab... X
R0012224 (Q27)	Enab... X
R0012218 (Q21)	
R0012215 (Q18)	
R0012207 (Q10)	
R0012210 (Q13)	

Create Orthophotos



Create Digital Surface Models





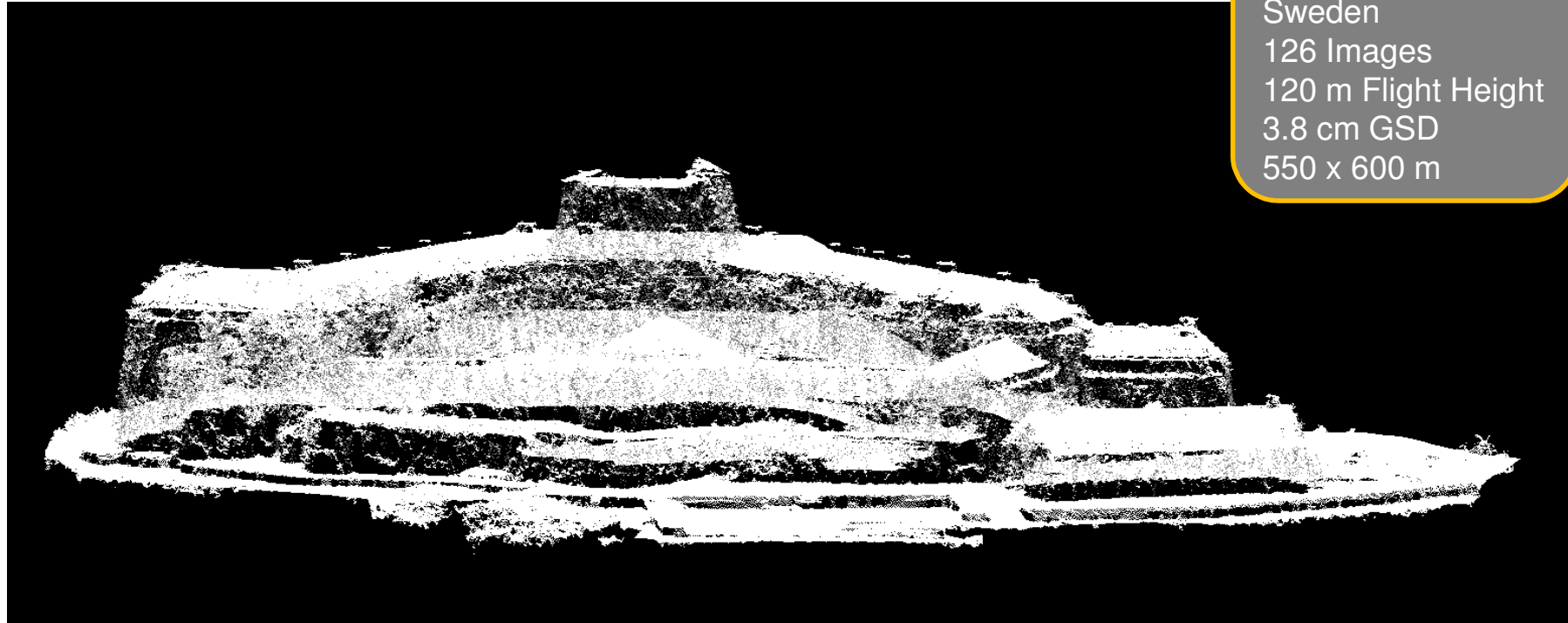
Vaxholm Castle,
Sweden
126 Images
120 m Flight Height
3.8 cm GSD
550 x 600 m



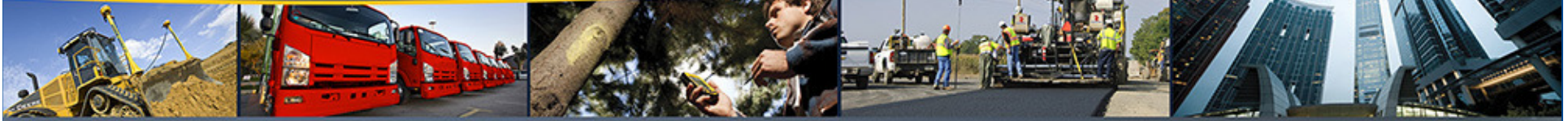
Vaxholm Castle,
Sweden
126 Images
120 m Flight Height
3.8 cm GSD
550 x 600 m



Vaxholm Castle,
Sweden
126 Images
120 m Flight Height
3.8 cm GSD
550 x 600 m



Vaxholm Castle,
Sweden
126 Images
120 m Flight Height
3.8 cm GSD
550 x 600 m

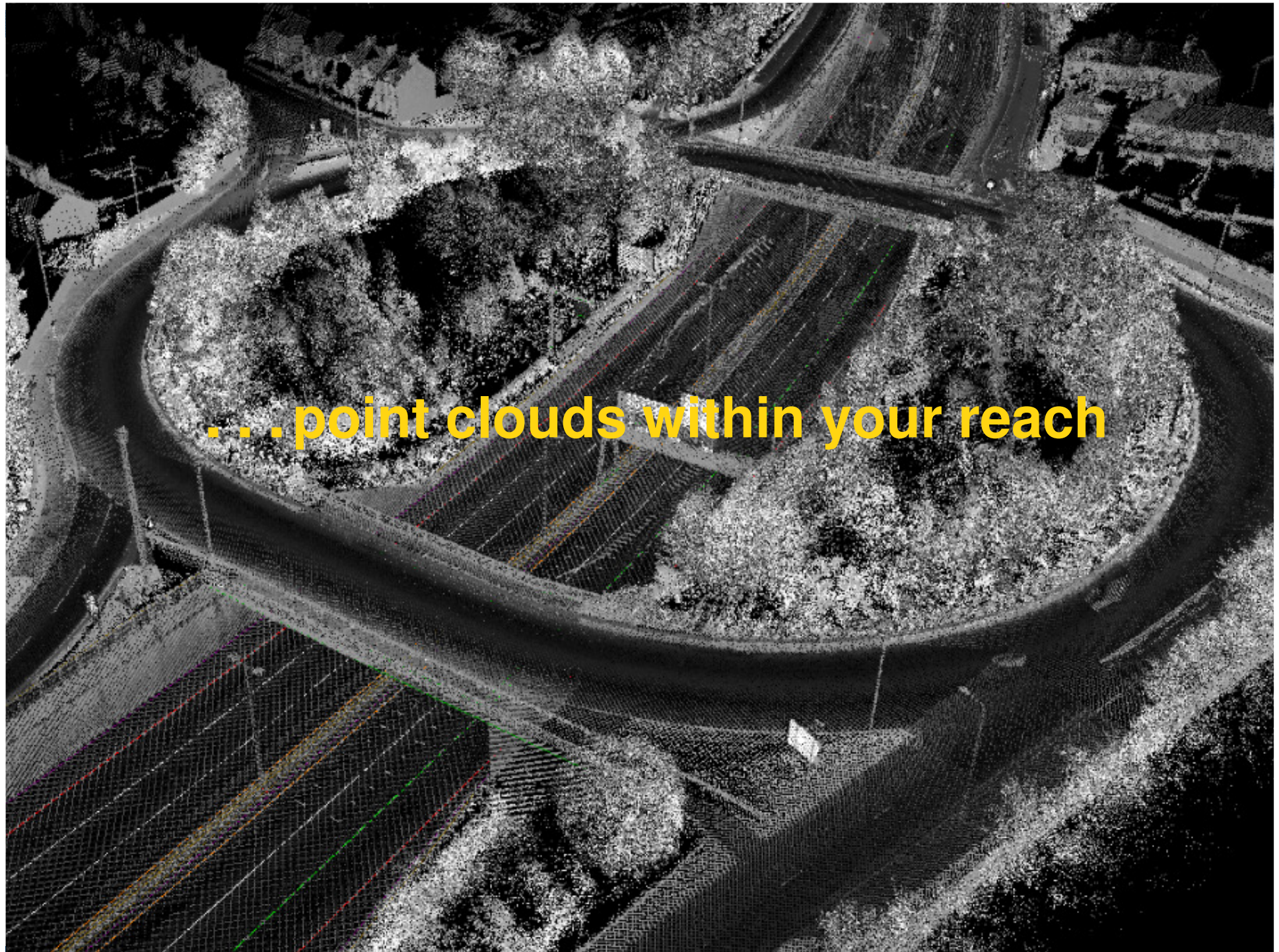


transforming the way the world works



Trimble MX2

‘For surveyors who want to
be in the driving seat!’

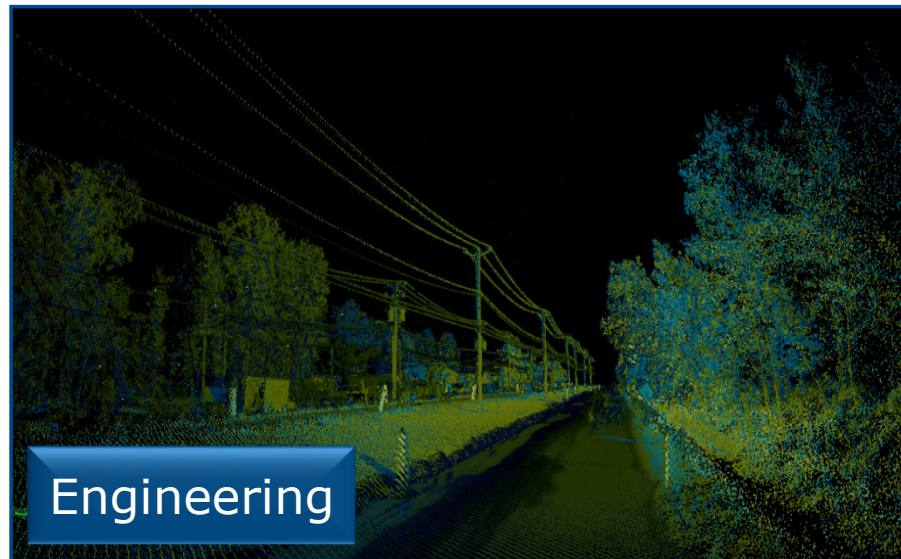
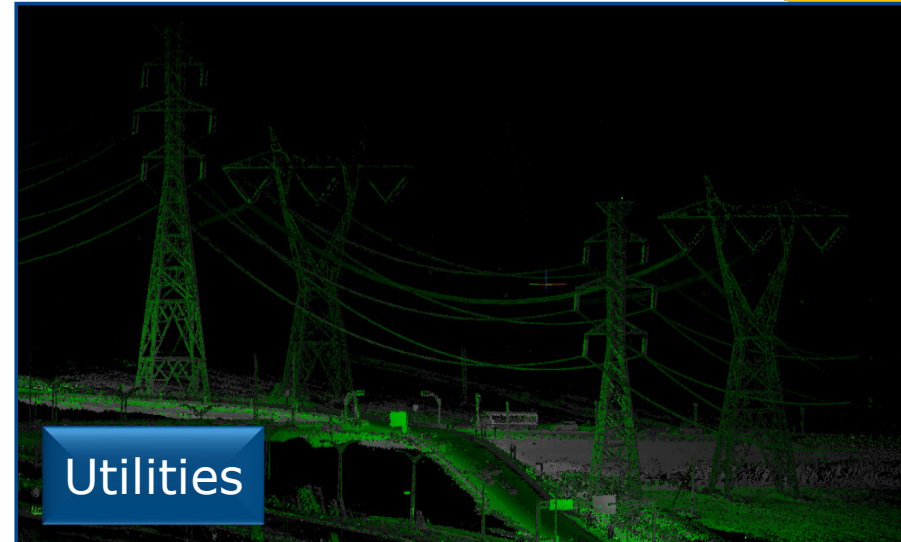
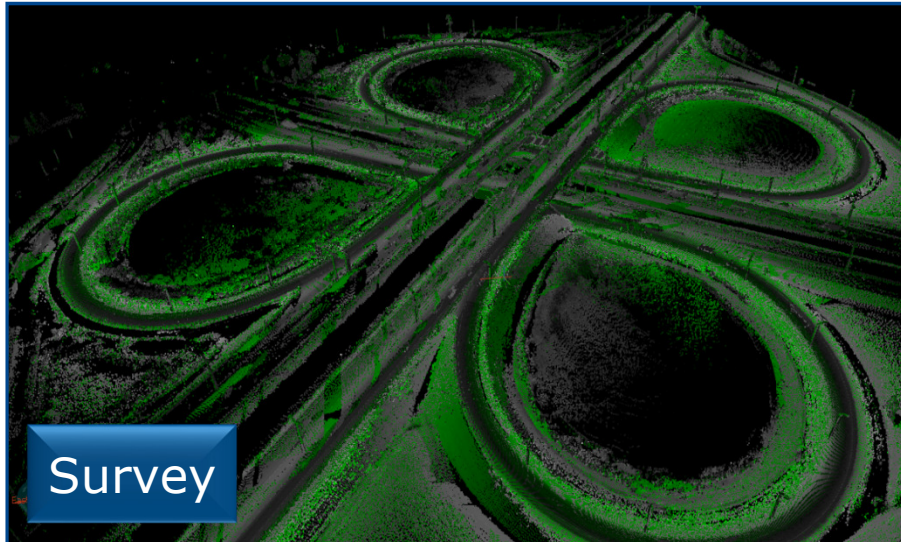


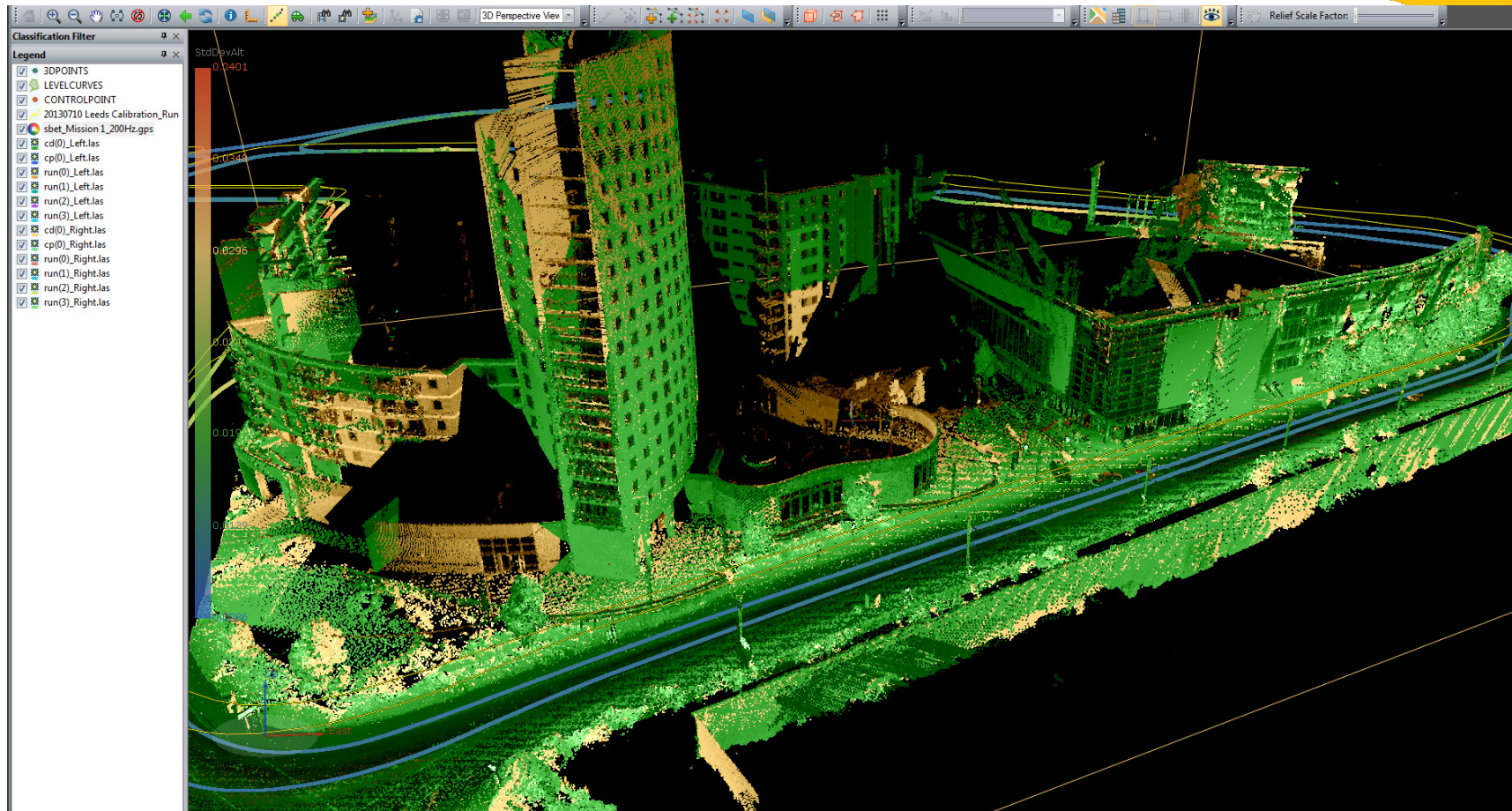
...point clouds within your reach

Installed System

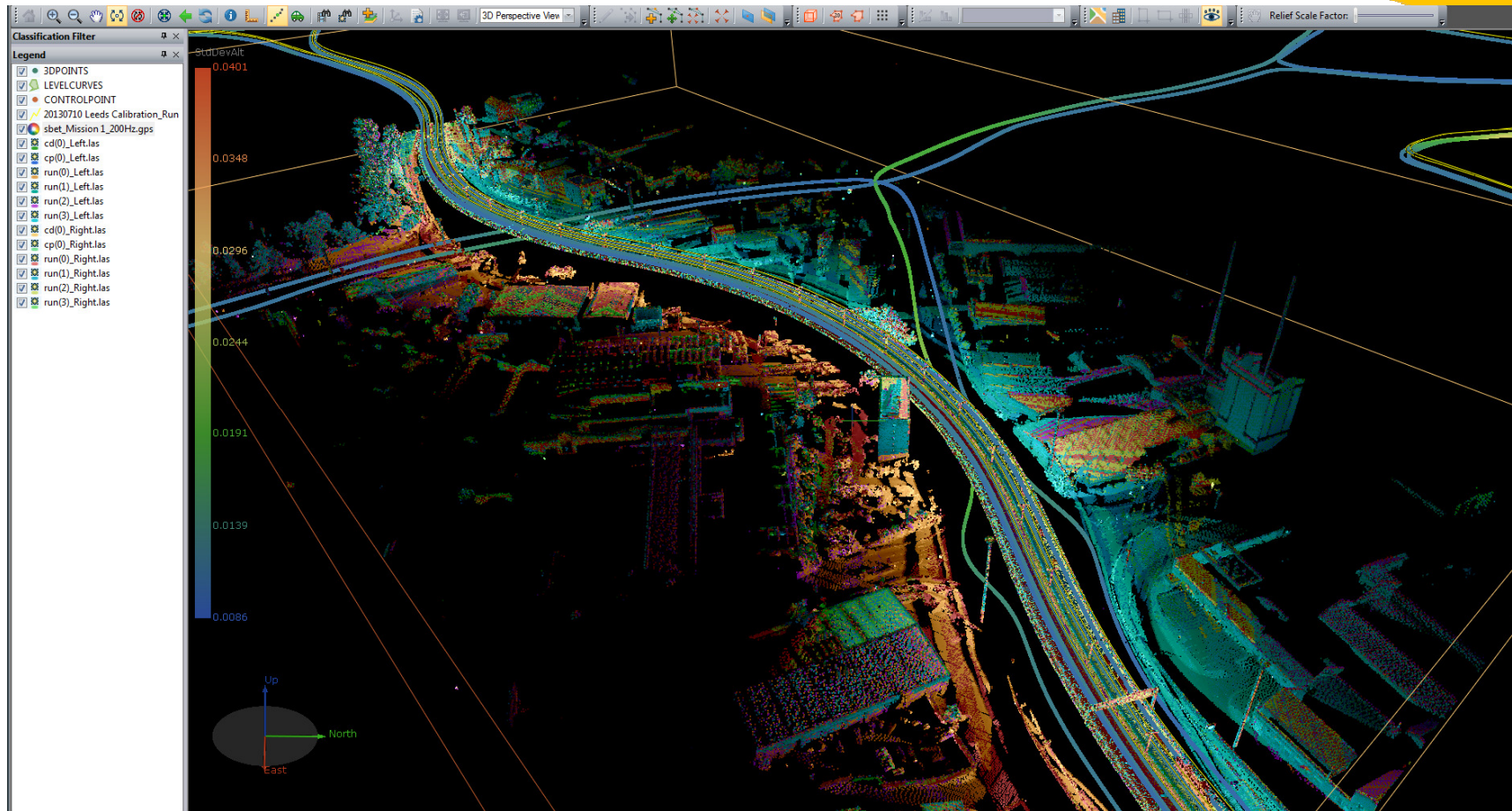


Trimble MX2 Applications

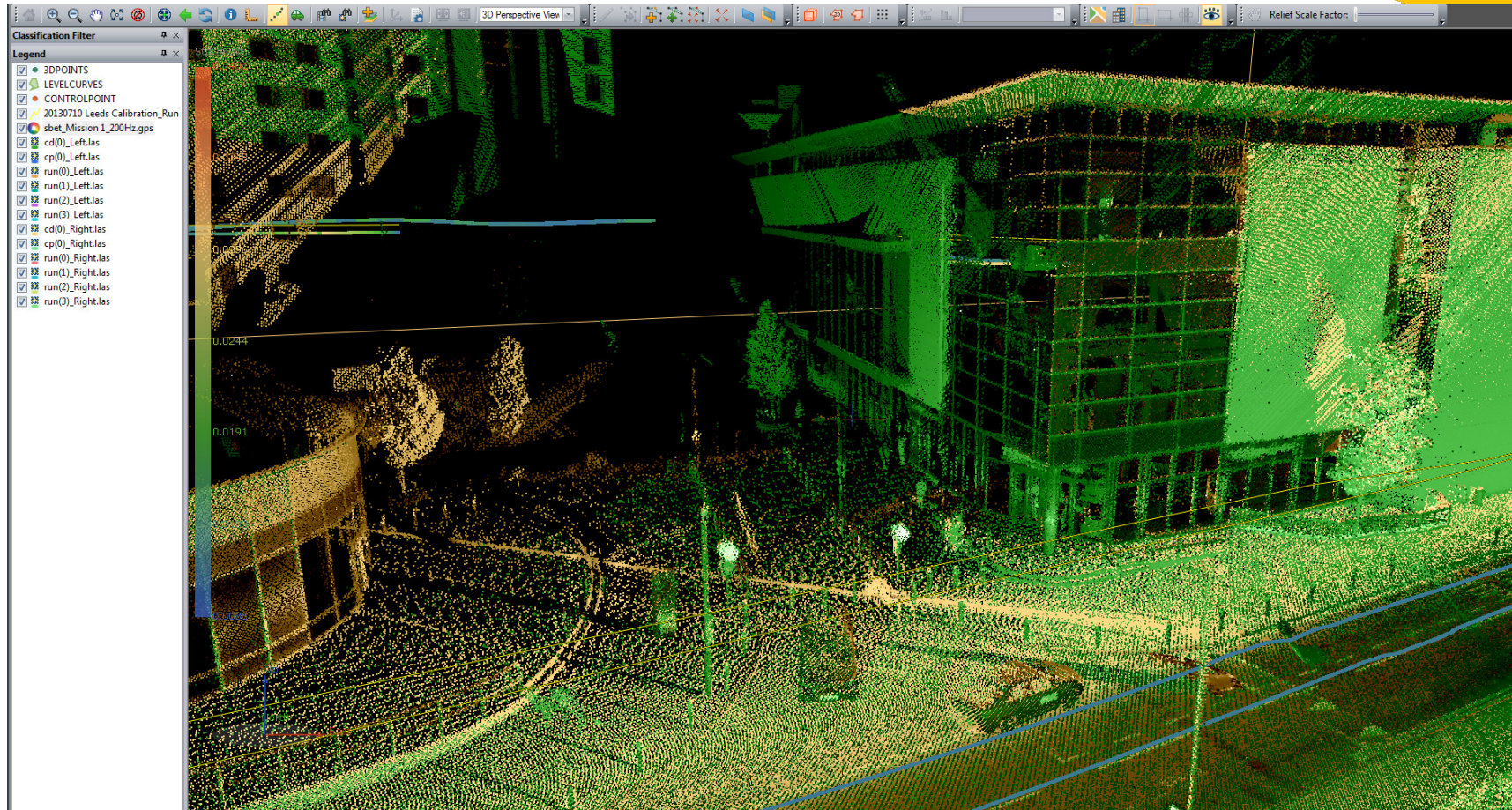




Clarence Dock

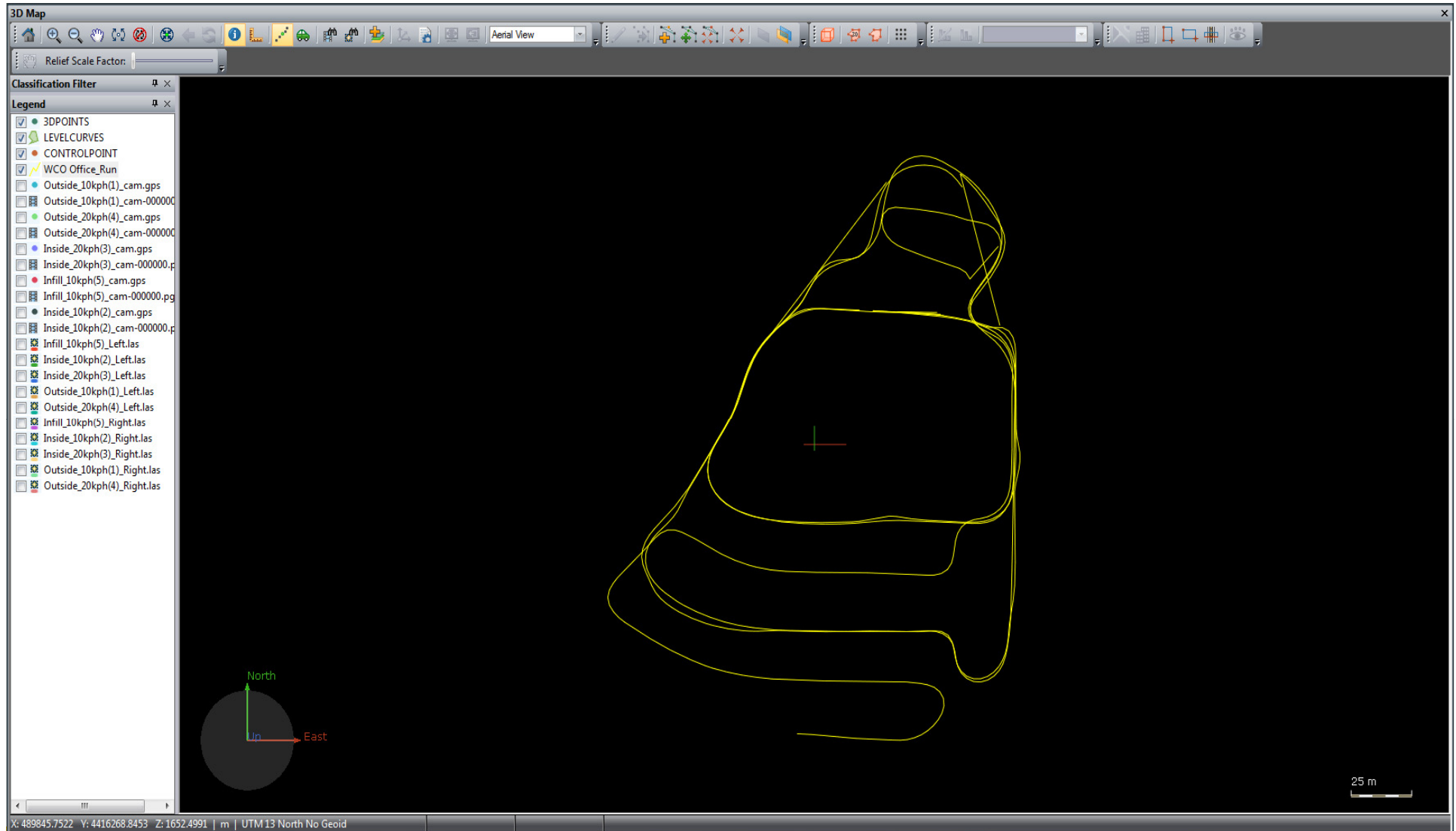


Flyover



Tesco

MX2 Data Trimble Office WCO



Our new home...





transforming the way the world works



Thank you...

‘Any questions?’