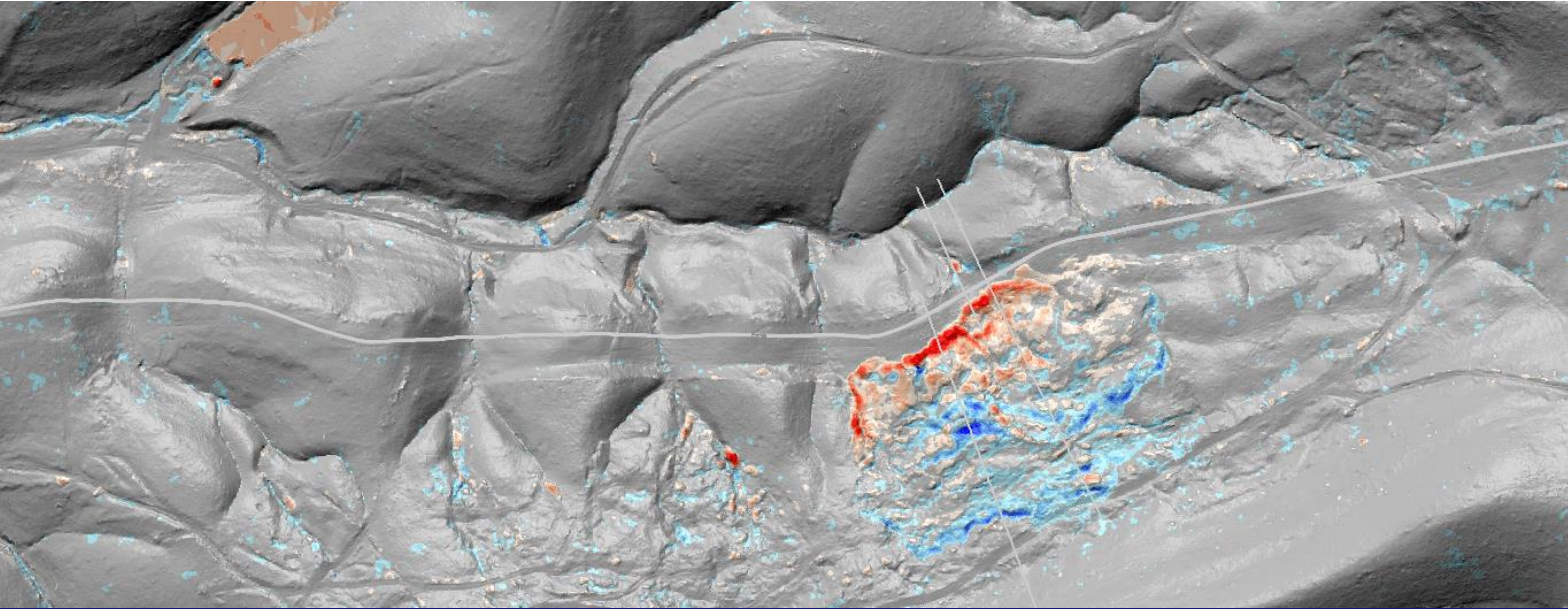


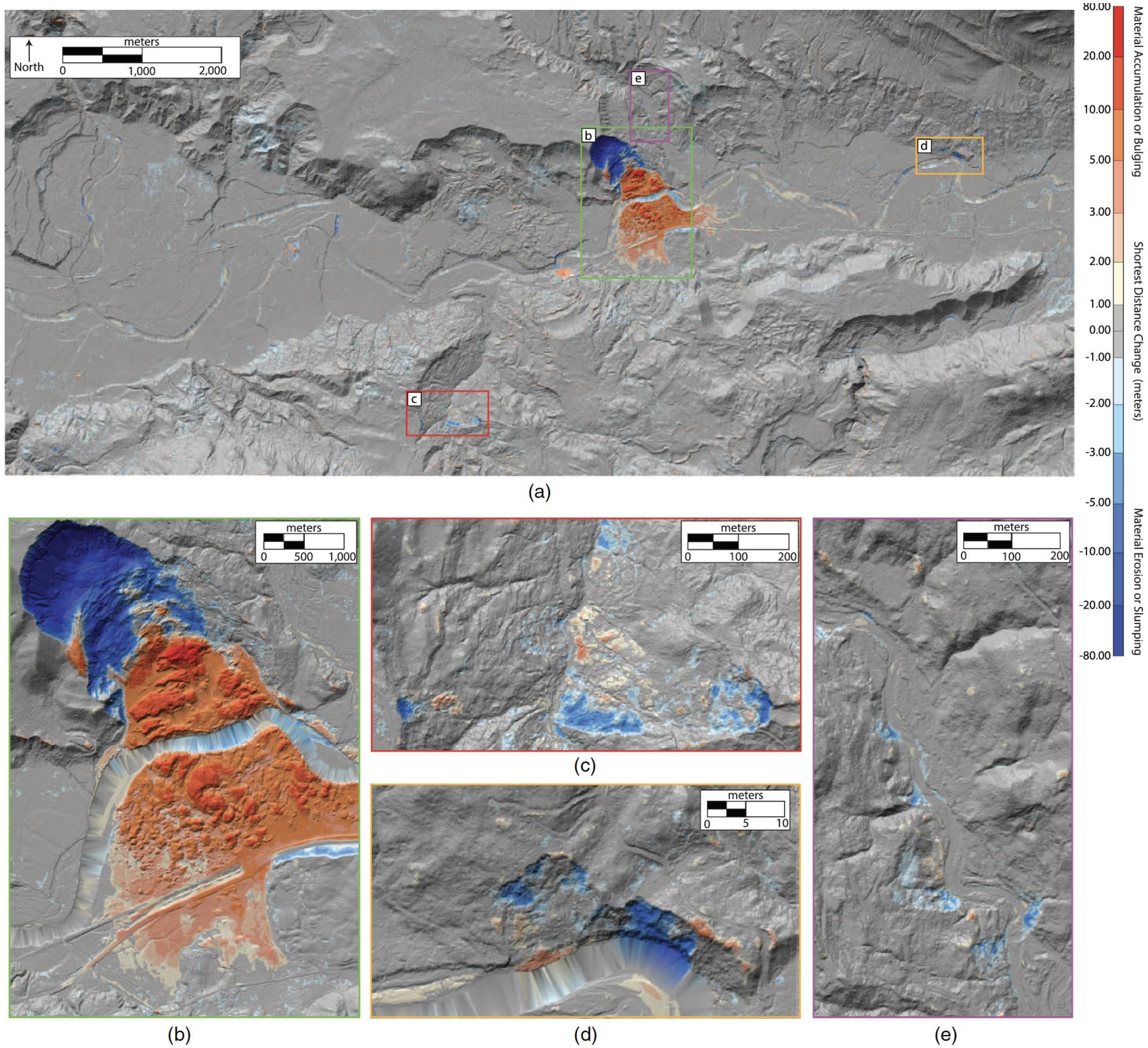
# Corridor scale lidar change detection

**Presented by:** Matt Lato, Ph.D., P.Eng.

**Date:** January 6, 2021

BGC

# Airborne lidar change detection: single site




Except from: **Reducing Landslide Risk Using Airborne Lidar Scanning Data**
Lato et al. 2019 *ASCE Journal of Geotechnical and Geoenvironmental Engineering*

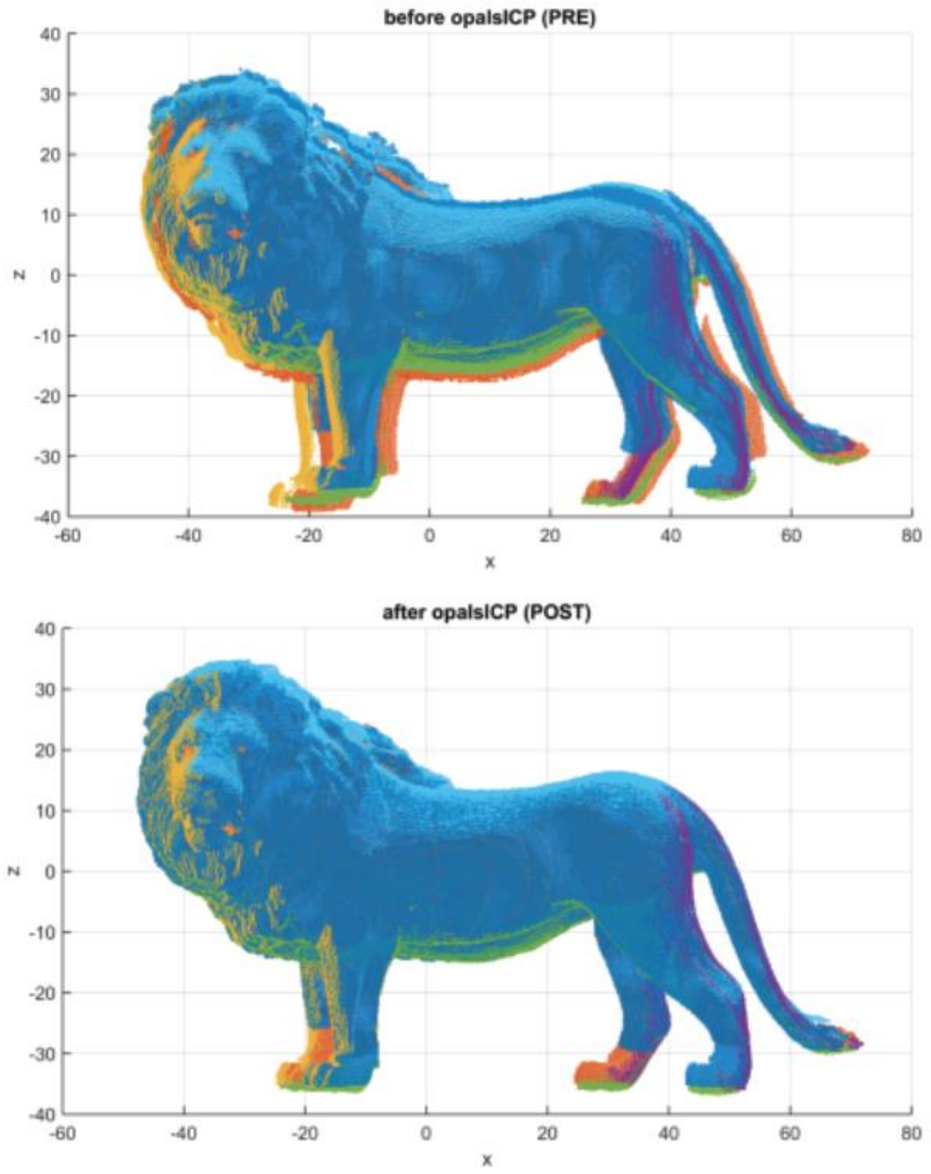
"…ALS data collected at different points in time can be used to map landslide activity, which is known to be a precursor to landslide failure.

…ALS data…can be used to identify terrain stability classes, landslide runout distances, and relative landslide age.

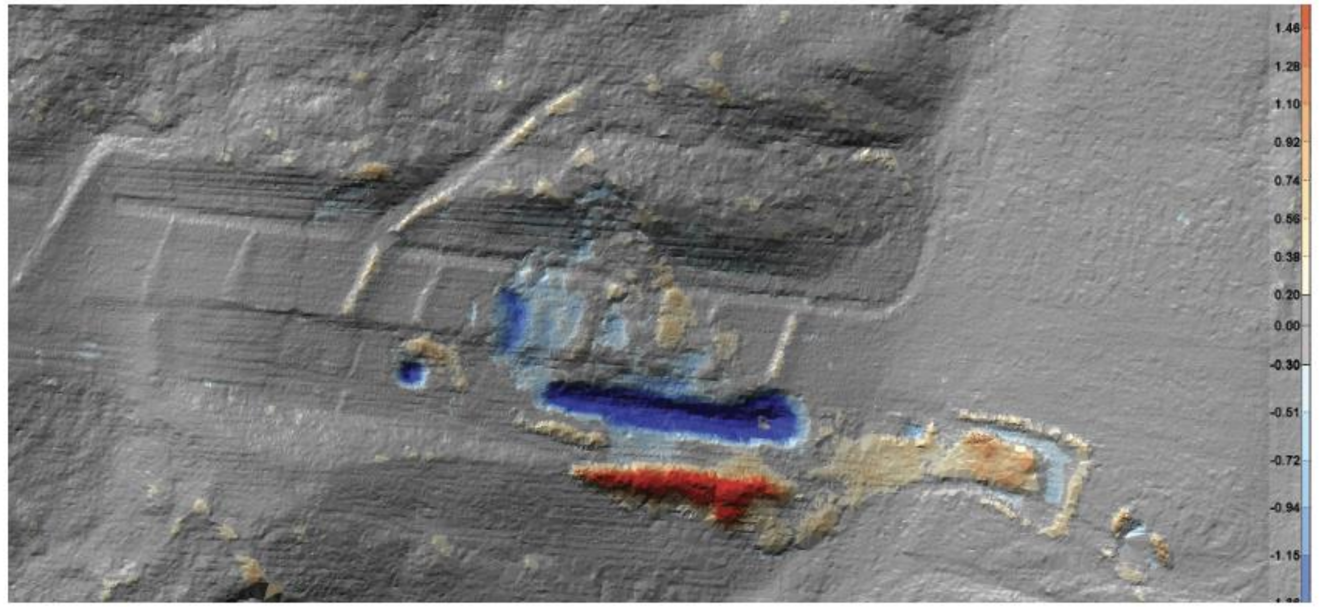
The combination of knowledge derived from these analyses with publicly available data for road networks and population density can be used by public and private organizations to develop comprehensive risk maps."

# 3D lidar change detection

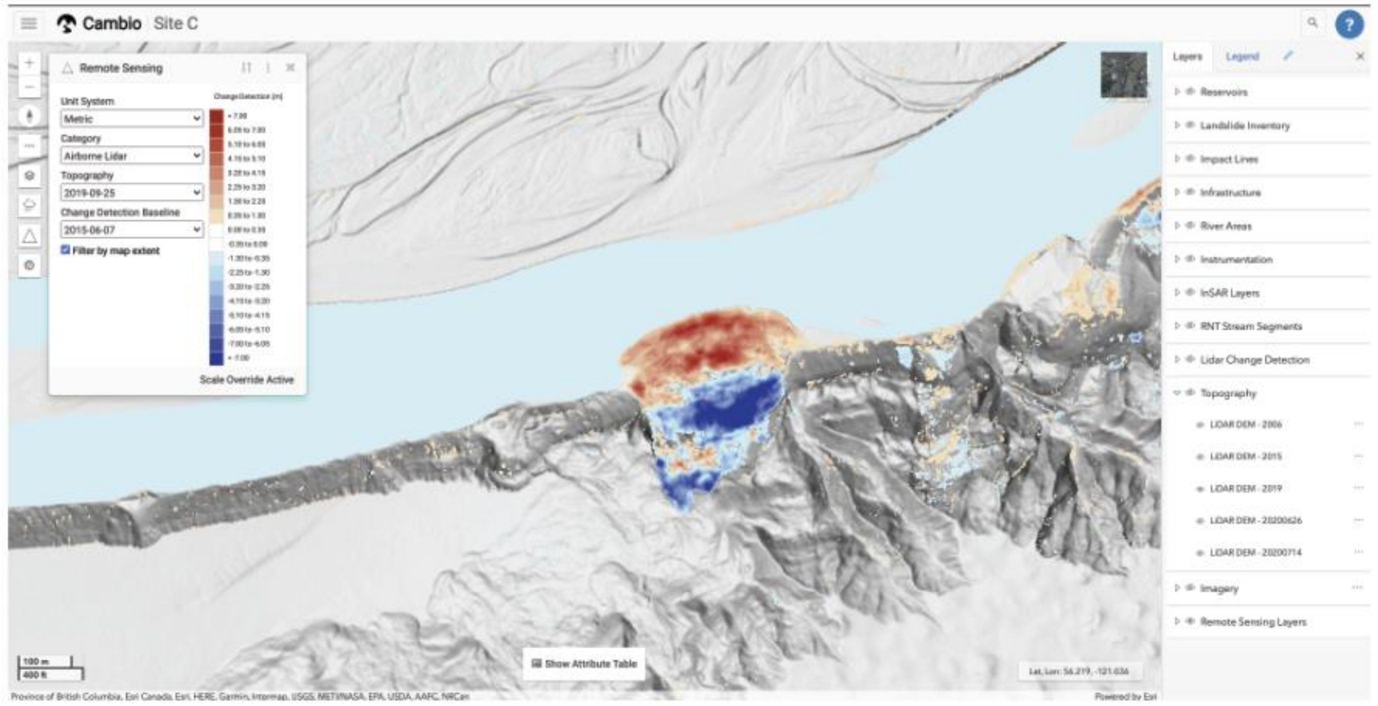
Minimize local errors
(correct for different GPS/INS solutions)
BGC utilizes a multi-step iterative closest point alignment procedure



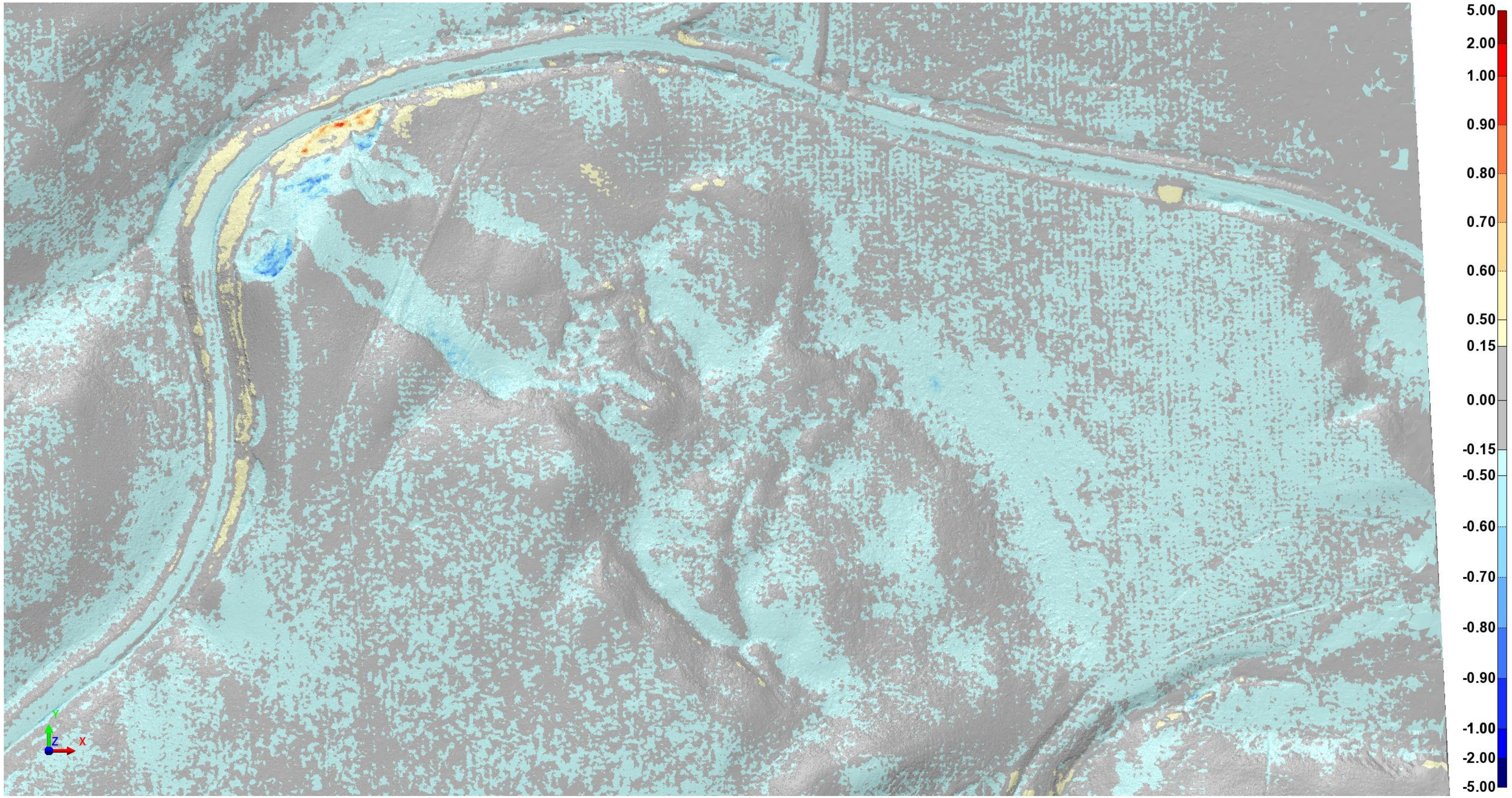

3D change detection analysis
BGC utilizes a 3D shortest distance approach
(sometimes we use a M3C2 approach)



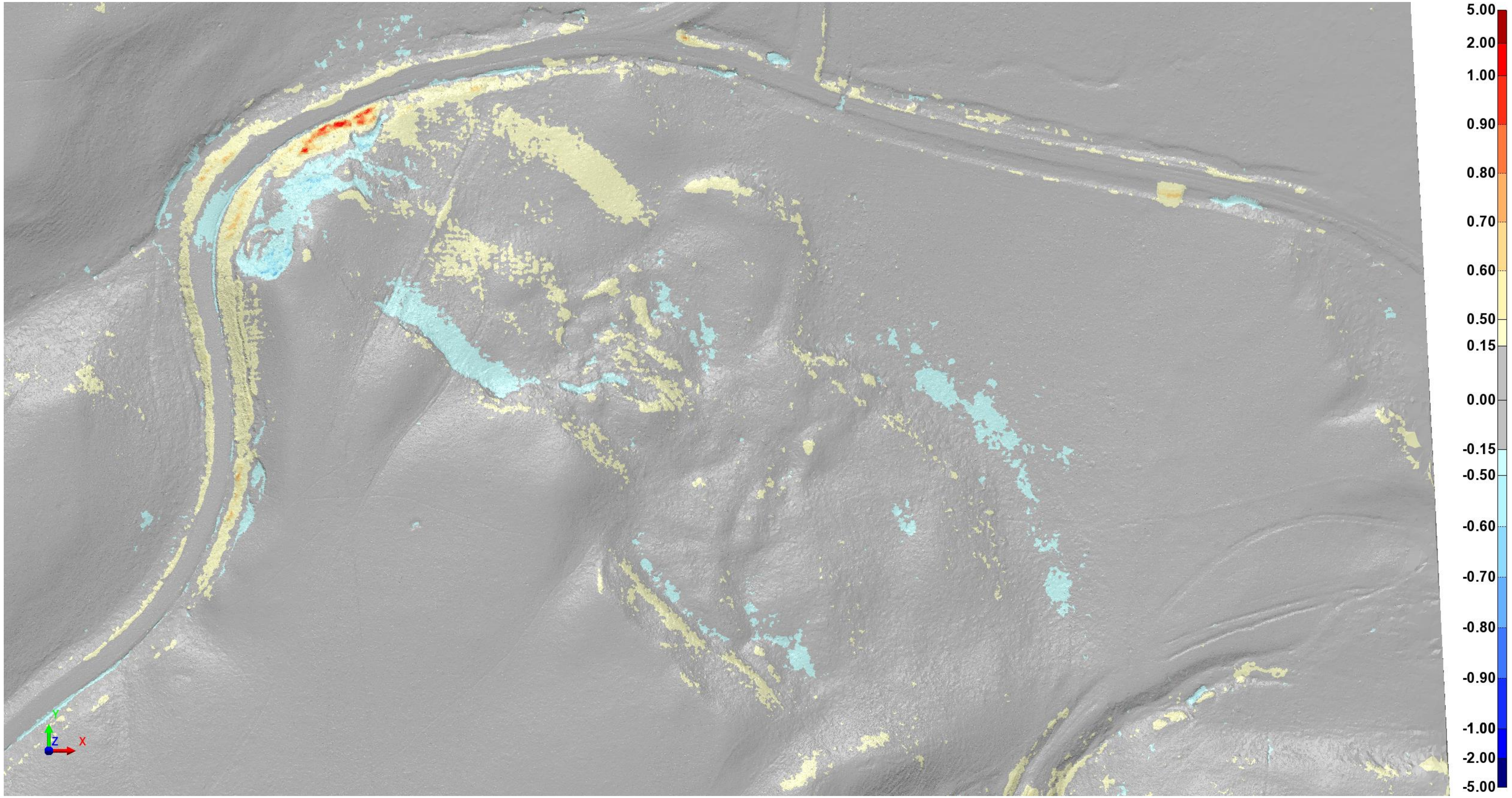

Azure blob storage of cloug optimized tiffs
in bigtiff format



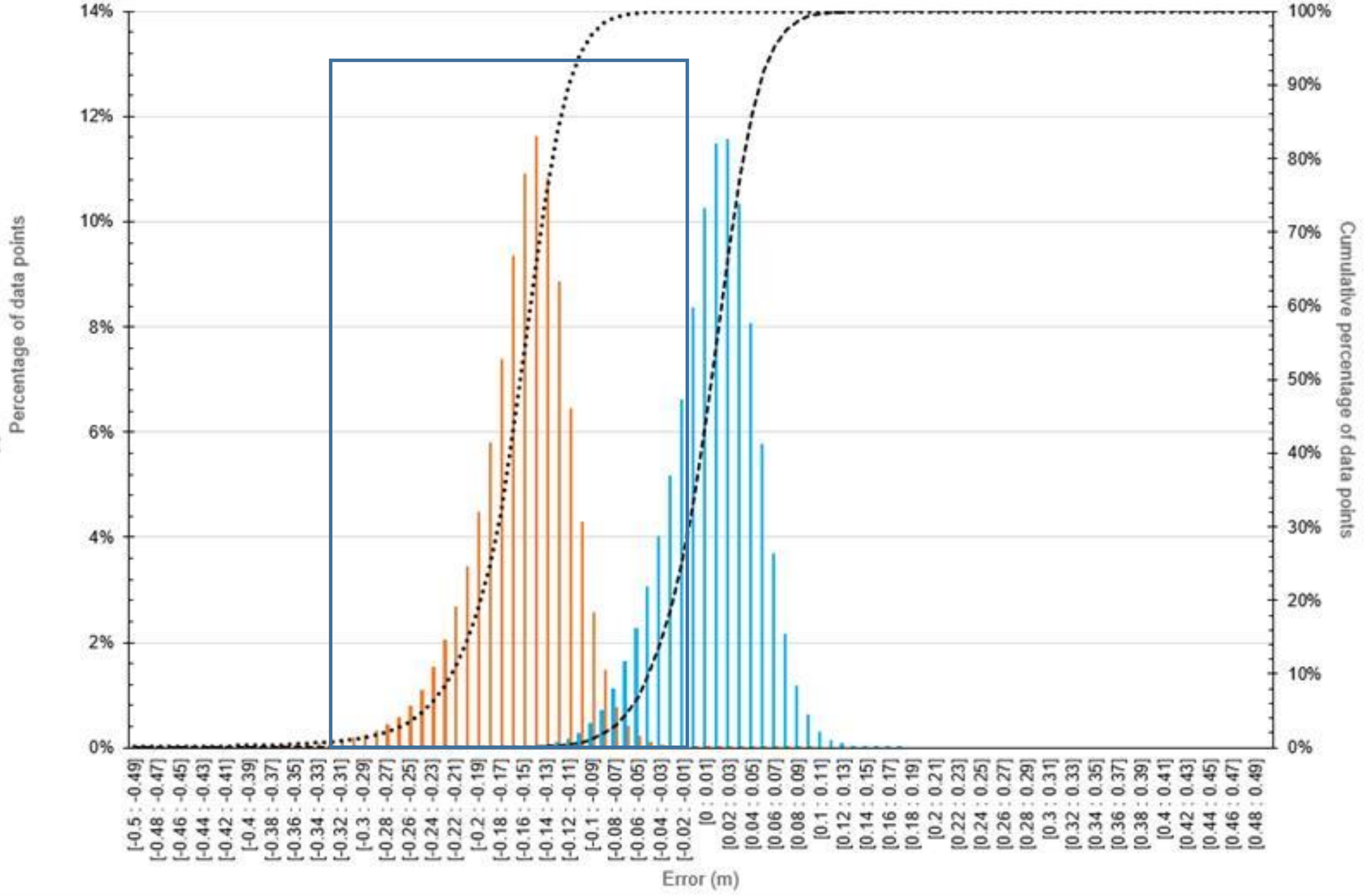
# Not using an ICP spatial realignment



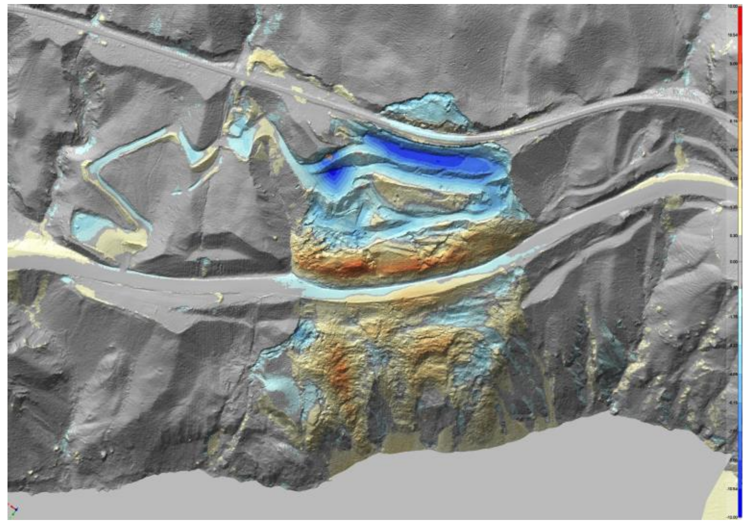
# Using an ICP spatial realignment



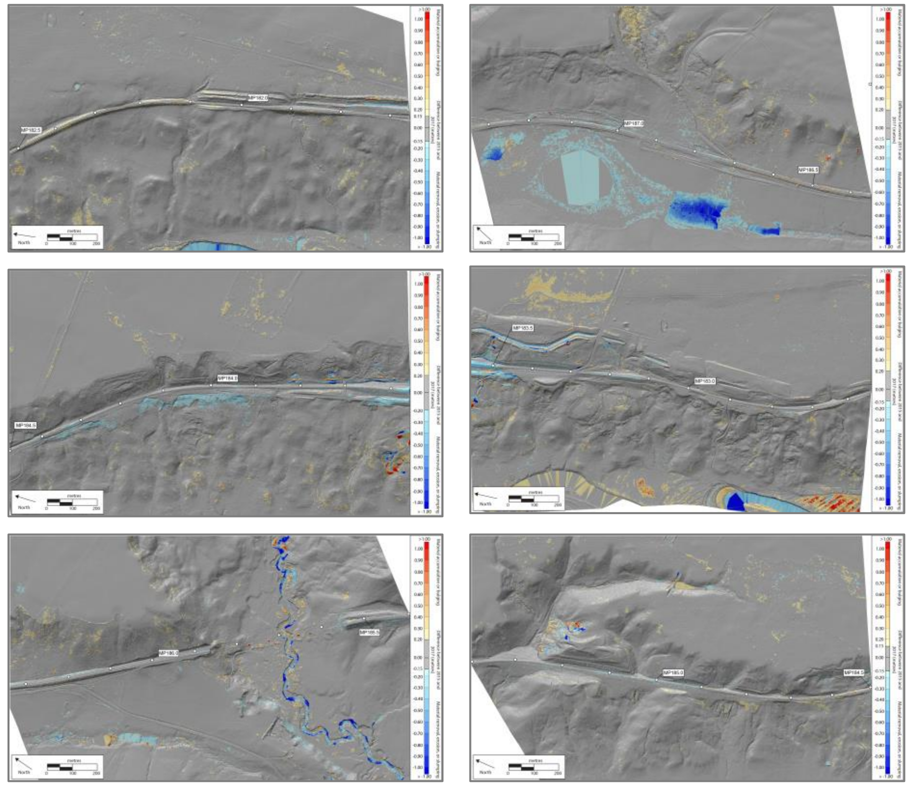
# What’s happening with the data



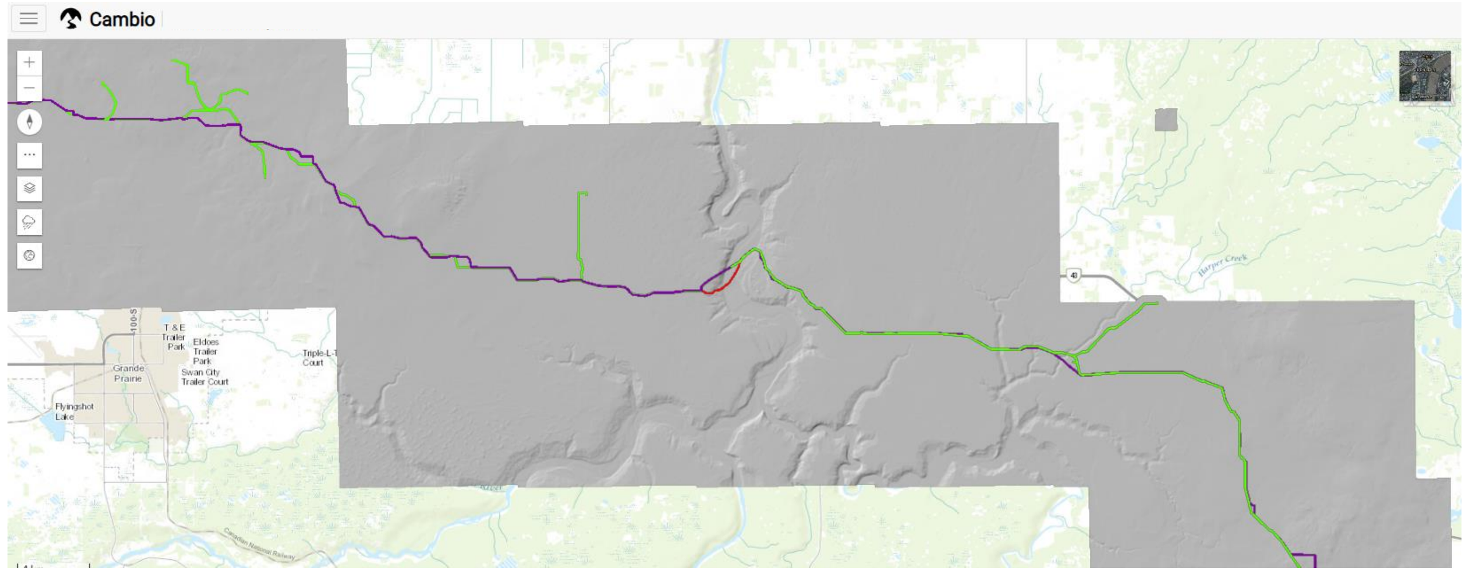
# Regional Scale Slope Movement Screening and Integration



Single site scale, manual process
Results delivered in figures or drawings



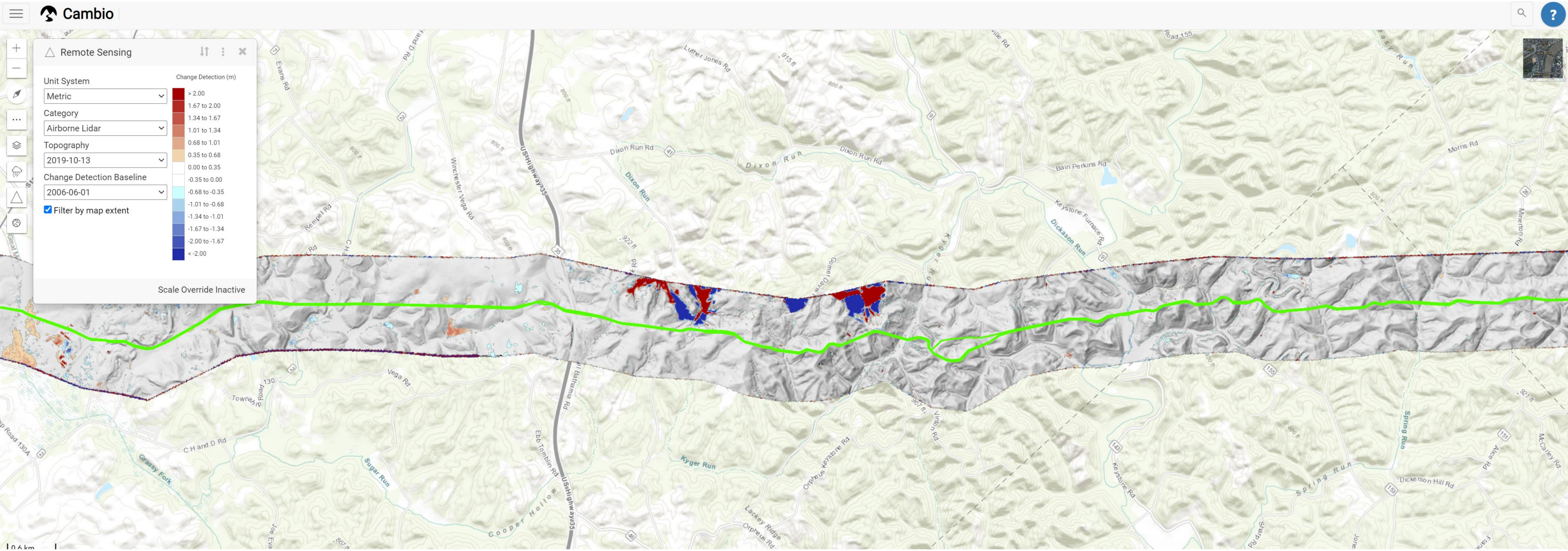
Corridor scale, some automation, onerous process to deliver results

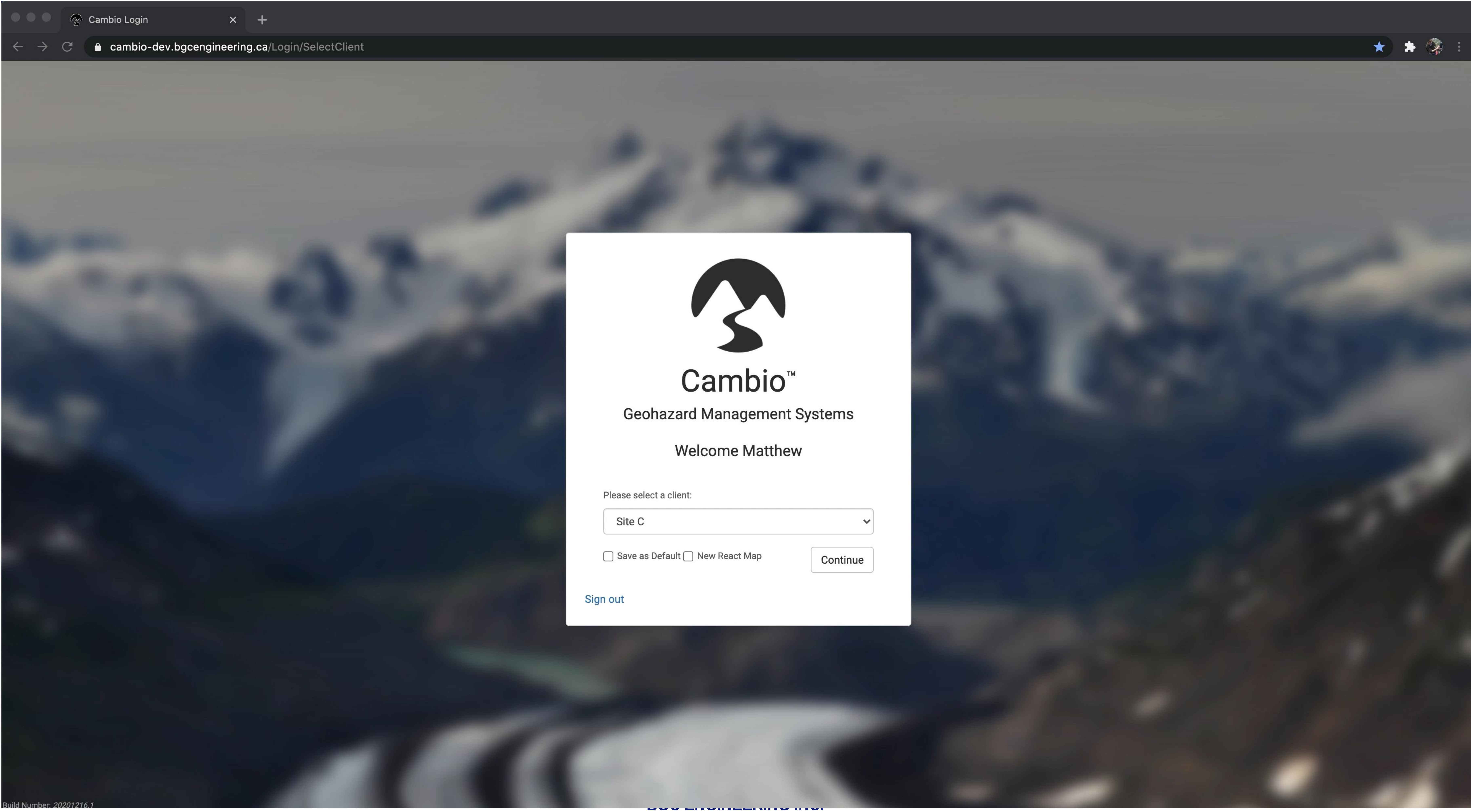


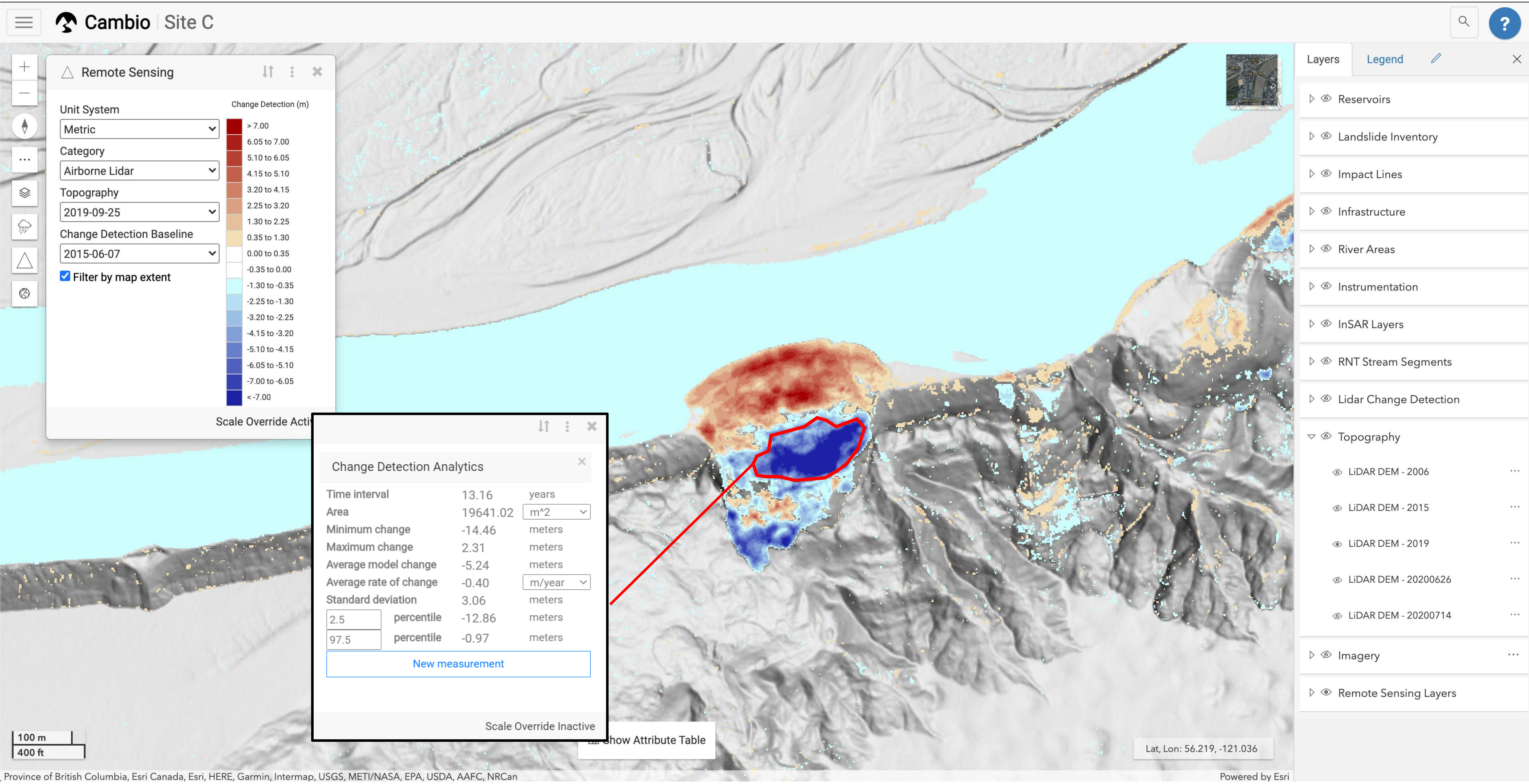

Regional scale, mostly automated work flow
Interactive results online
Use as a screening tool or for detailed analysis

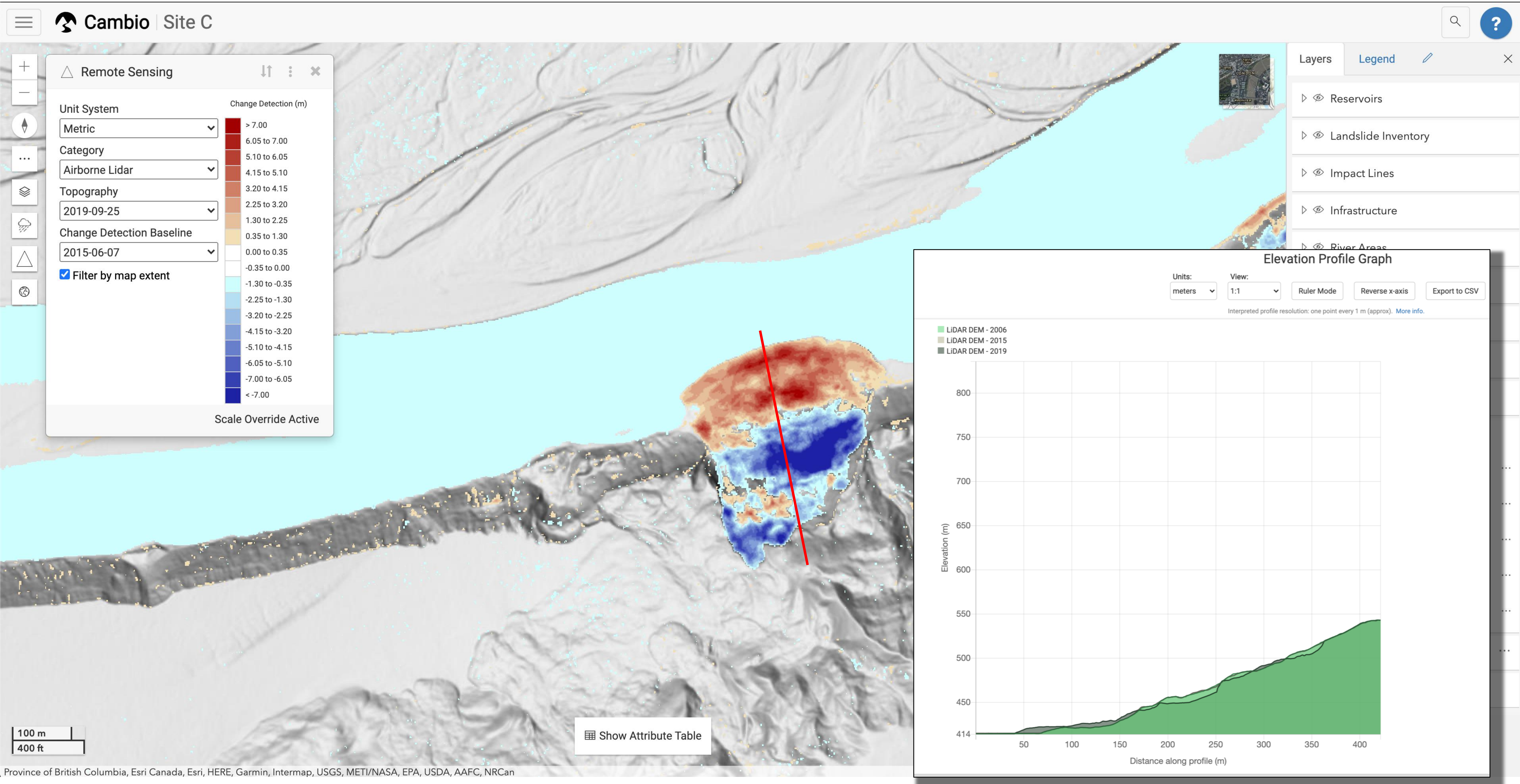
Integrate analysis with site inspections, photos, instrumentation, other remote sensing data (ex. InSAR)

# Regional Scale Slope Movement Screening and Integration




Cambio Login
cambio-dev.bgcengineering.ca/Login/SelectClient
Cambio™
Geohazard Management Systems
Welcome Matthew
Please select a client:
Site C
Save as Default
New React Map
Continue
Sign out
Build Number: 20201216.1


Cambio | Site C
Remote Sensing
Unit System
Metric
Category
Airborne Lidar
Topography
2019-09-25
Change Detection Baseline
2015-06-07
Filter by map extent
Change Detection (m)
> 7.00
6.05 to 7.00
5.10 to 6.05
4.15 to 5.10
3.20 to 4.15
2.25 to 3.20
1.30 to 2.25
0.35 to 1.30
0.00 to 0.35
-0.35 to 0.00
-1.30 to -0.35
-2.25 to -1.30
-3.20 to -2.25
-4.15 to -3.20
-5.10 to -4.15
-6.05 to -5.10
-7.00 to -6.05
< -7.00
Change Detection Analytics
Time interval 13.16 years
Area 19641.02 m^2
Minimum change -14.46 meters
Maximum change 2.31 meters
Average model change -5.24 meters
Average rate of change -0.40 m/year
Standard deviation 3.06 meters
2.5 percentile -12.86 meters
97.5 percentile -0.97 meters
New measurement
Scale Override Inactive
Show Attribute Table
Lat, Lon: 56.219, -121.036
100 m
400 ft
Province of British Columbia, Esri Canada, Esri, HERE, Garmin, Intermap, USGS, METI/NASA, EPA, USDA, AAFC, NRCan
Powered by Esri
Layers
Legend
Reservoirs
Landslide Inventory
Impact Lines
Infrastructure
River Areas
Instrumentation
InSAR Layers
RNT Stream Segments
Lidar Change Detection
Topography
LiDAR DEM - 2006
LiDAR DEM - 2015
LiDAR DEM - 2019
LiDAR DEM - 20200626
LiDAR DEM - 20200714
Imagery
Remote Sensing Layers


Cambio | Site C
Remote Sensing
Unit System
Metric
Category
Airborne Lidar
Topography
2019-09-25
Change Detection Baseline
2015-06-07
Filter by map extent
Change Detection (m)
> 7.00
6.05 to 7.00
5.10 to 6.05
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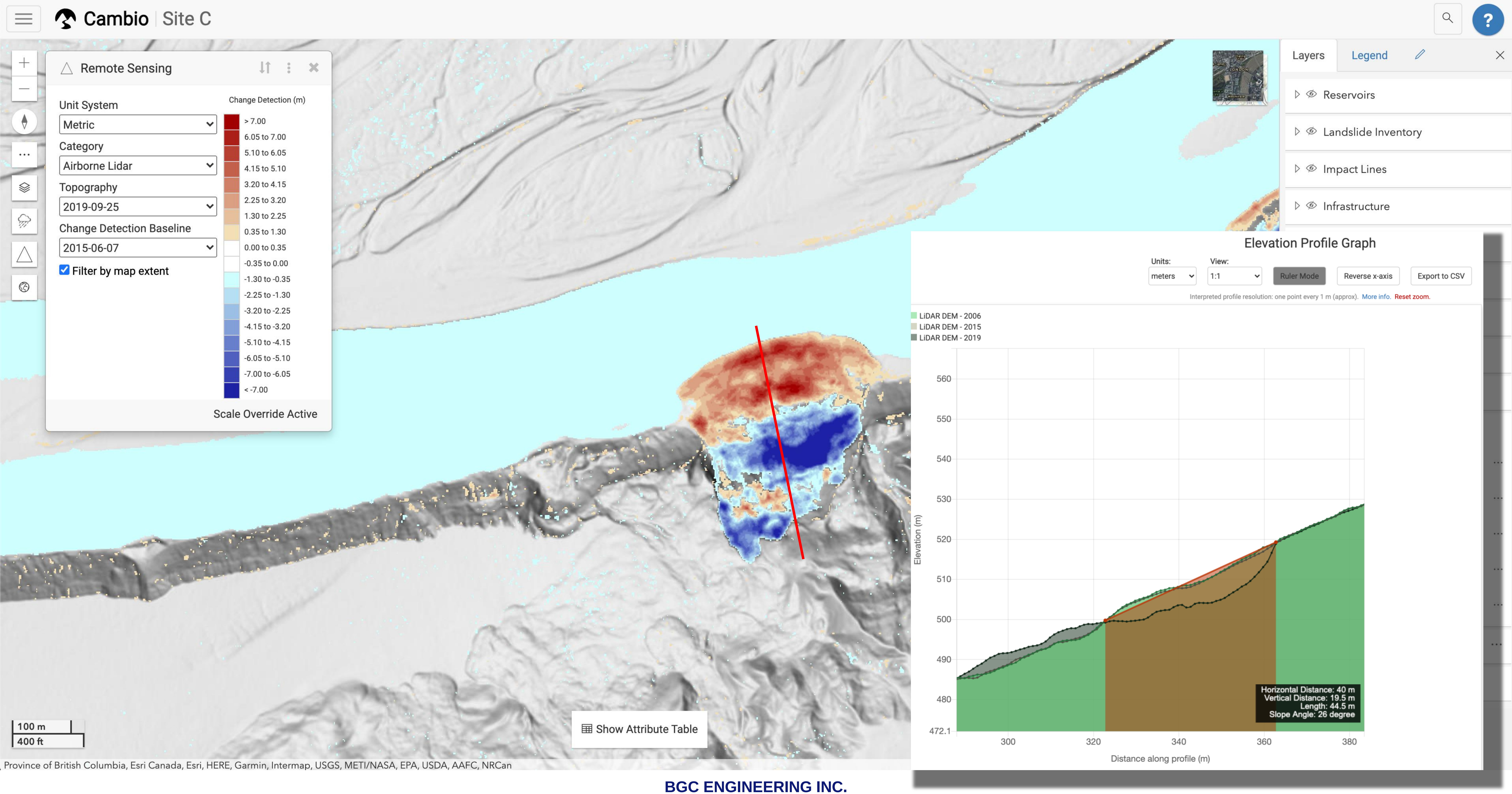
1.30 to 2.25
0.35 to 1.30
0.00 to 0.35
-0.35 to 0.00
-1.30 to -0.35
-2.25 to -1.30
-3.20 to -2.25
-4.15 to -3.20
-5.10 to -4.15
-6.05 to -5.10
-7.00 to -6.05
< -7.00
Scale Override Active
Layers
Legend
Reservoirs
Landslide Inventory
Impact Lines
Infrastructure
Elevation Profile Graph
Units:
meters
View:
1:1
Ruler Mode
Reverse x-axis
Export to CSV
Interpreted profile resolution: one point every 1 m (approx). More info.
LiDAR DEM - 2006
LiDAR DEM - 2015
LiDAR DEM - 2019
Elevation (m)
Distance along profile (m)
Show Attribute Table
100 m
400 ft
, Province of British Columbia, Esri Canada, Esri, HERE, Garmin, Intermap, USGS, METI/NASA, EPA, USDA, AAFC, NRCan


Cambio | Site C
Remote Sensing
Unit System
Metric
Category
Airborne Lidar
Topography
2019-09-25
Change Detection Baseline
2015-06-07
Filter by map extent
Change Detection (m)
> 7.00
6.05 to 7.00
5.10 to 6.05
4.15 to 5.10
3.20 to 4.15
2.25 to 3.20
1.30 to 2.25
0.35 to 1.30
0.00 to 0.35
-0.35 to 0.00
-1.30 to -0.35
-2.25 to -1.30
-3.20 to -2.25
-4.15 to -3.20
-5.10 to -4.15
-6.05 to -5.10
-7.00 to -6.05
< -7.00
Scale Override Active
Layers
Legend
Reservoirs
Landslide Inventory
Impact Lines
Infrastructure
Elevation Profile Graph
Units:
meters
View:
1:1
Ruler Mode
Reverse x-axis
Export to CSV
Interpreted profile resolution: one point every 1 m (approx). More info. Reset zoom.
LiDAR DEM - 2006
LiDAR DEM - 2015
LiDAR DEM - 2019
Elevation (m)
Distance along profile (m)
Horizontal Distance: 40 m
Vertical Distance: 19.5 m
Length: 44.5 m
Slope Angle: 26 degree
100 m
400 ft
Show Attribute Table
Province of British Columbia, Esri Canada, Esri, HERE, Garmin, Intermap, USGS, METI/NASA, EPA, USDA, AAFC, NRCan

# Conclusion

- ALS change detection at a regional scale is possible
- Analysis can be completed with highly efficient semi-automated processes
- Results can be provided over web and mobile platforms
- Data can be combined with other monitoring techniques, asset information, and construction and inspection information.
- Forward looking integration with climate and machine learning algorithms for activity prediction

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