

# i<sup>2</sup>MON – Integrated Mining Impact Monitoring



**Ground Sensor Monitoring - User Workshop 07.12.2021**

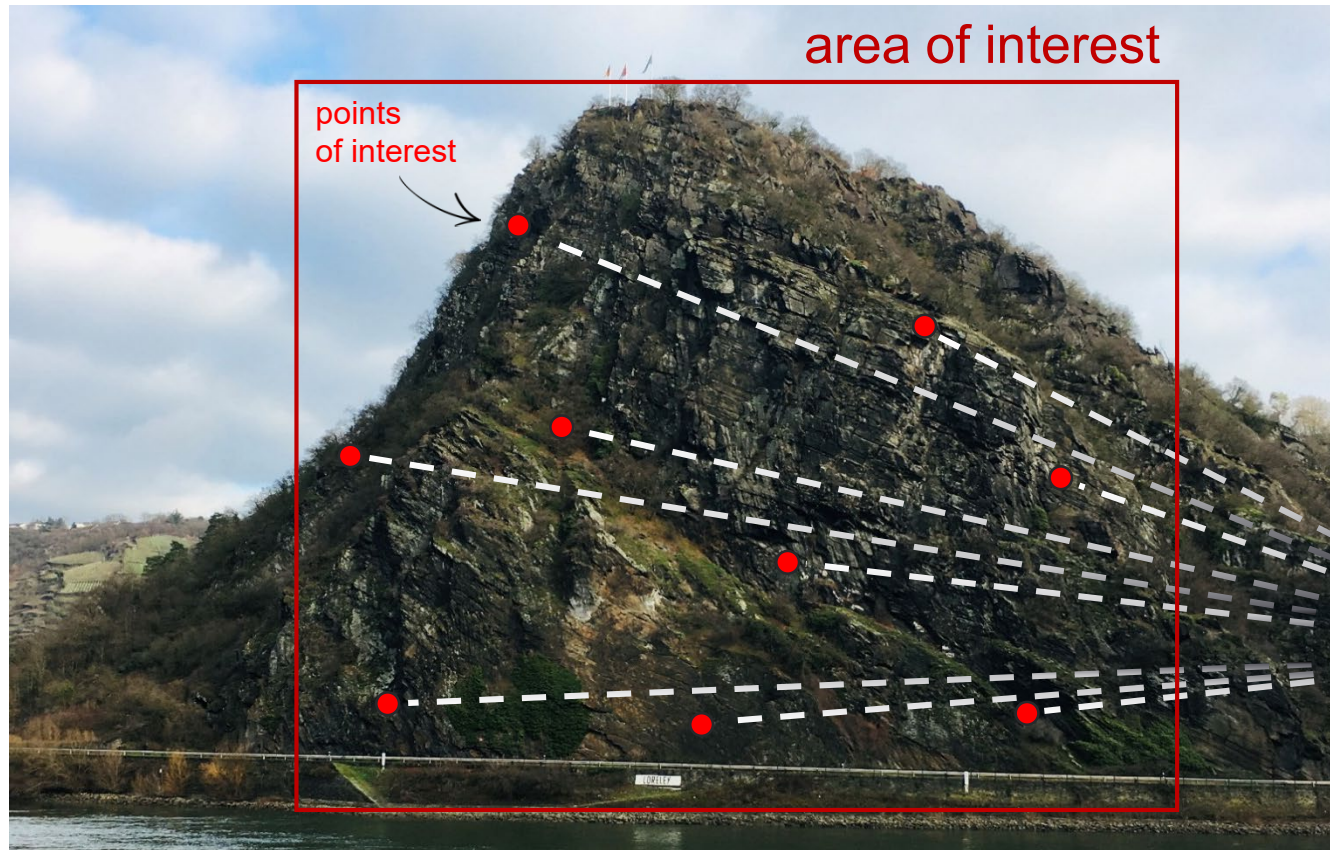
Denise Becker (M.Sc.), Laura Raddatz (M.Sc.), Prof. Dr.-Ing. Jörg Klonowski



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**HOCHSCHULE MAINZ**  
UNIVERSITY OF  
APPLIED SCIENCES

Institut für raumbezogene  
Informations- und Messtechnik  
Hochschule Mainz

## ■ Example: slope



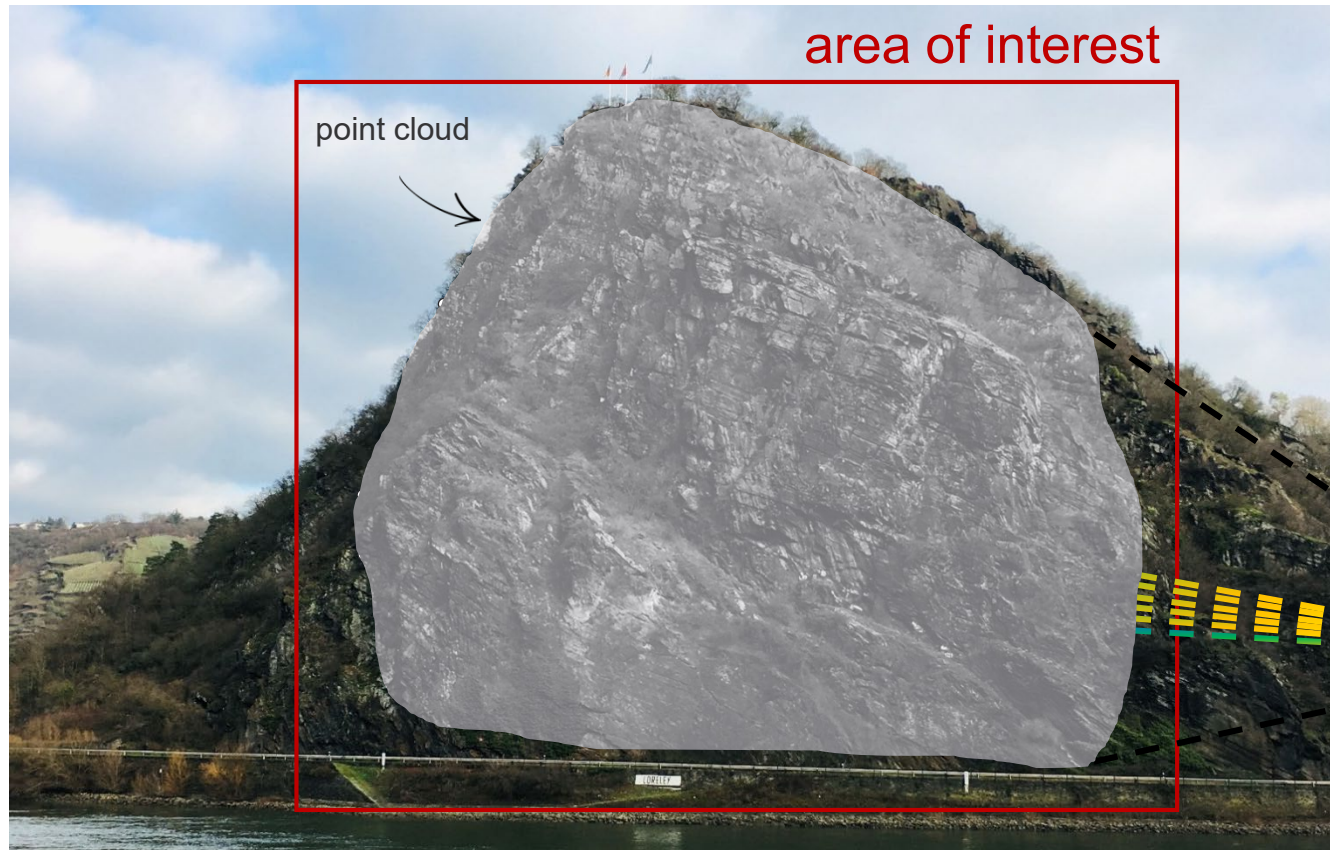
- measurement of all discrete points one after the other
- single point address
- high measuring accuracy



Source: <https://de.cleanpng.com/png-d60gws/>



## ■ Example: slope



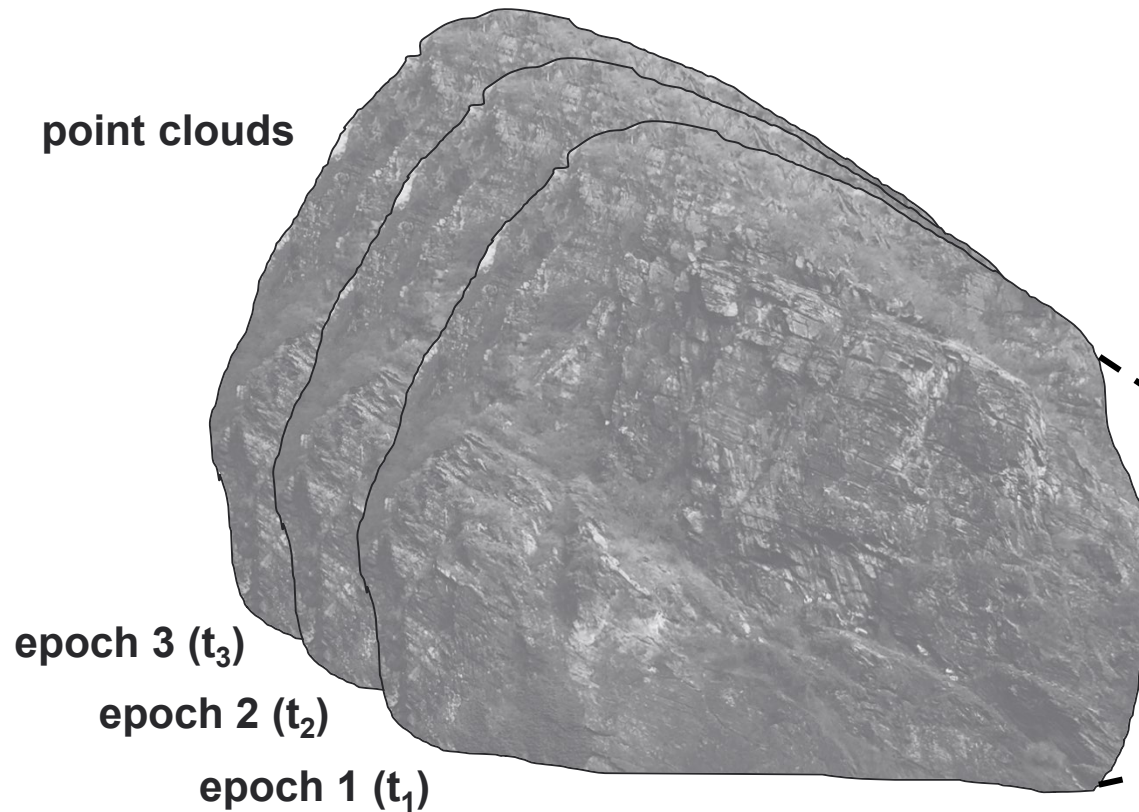
- scanning for long ranges
- recording of a surface consisting of millions of points
- fast object acquisition

terrestrial laser scanning  
(TLS)



Source: <https://kb.unavco.org/kb/article/unavco-summary-of-riegl-vz-2000-820.html>

## ■ Example: slope

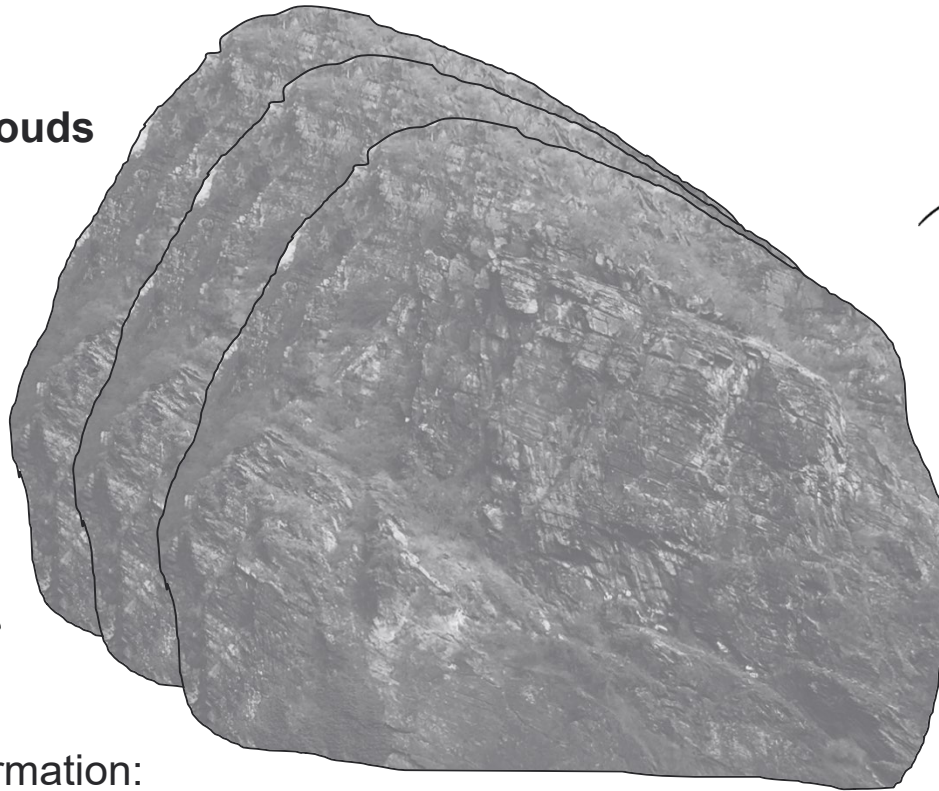


- different point clouds at different times  
= different epochs
- detection of changes by differences of 2 epochs



Source: <https://kb.unavco.org/kb/article/unavco-summary-of-riegl-vz-2000-820.html>

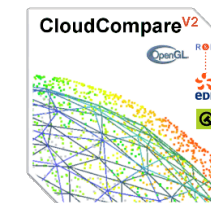
point clouds



types of deformation:  
→ solid body movement  
→ dynamic deformation

**3D Feature-based methods  
(with descriptors)**  
defining features e.g. neighborhood  
relations of points in terms of distance and  
orientation

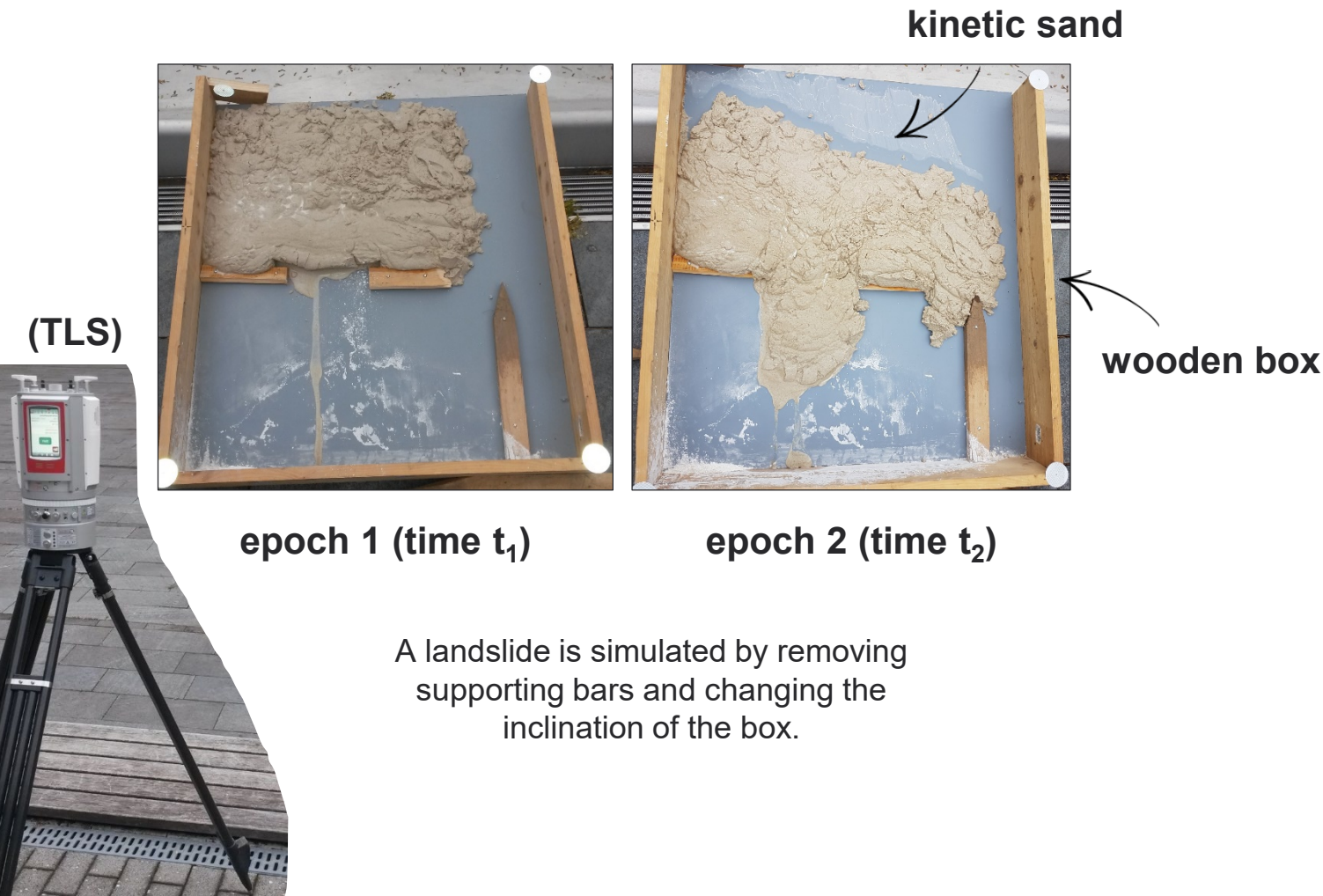
**Area-based methods  
(with open source software Cloud Compare)**  
standard methods:  
C2C = Cloud-to-Cloud  
C2M = Cloud-to-Mesh  
M3C2 = Multiscale Model to Model



Source: <https://www.danielgm.net/cc/>



# 3 Test experiment – simulation of a landslide



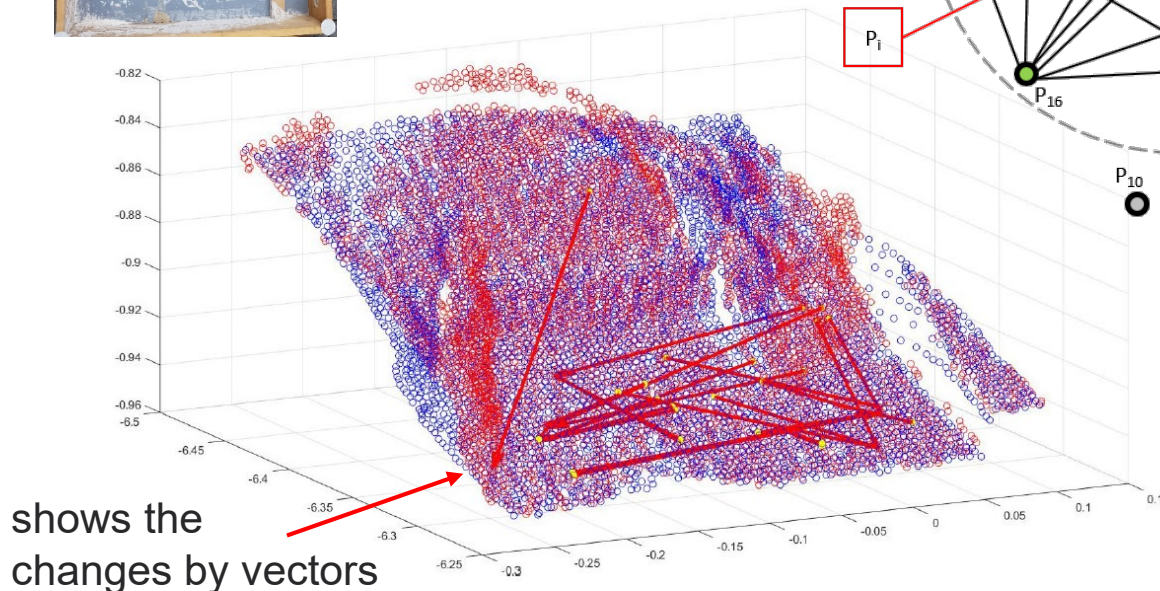
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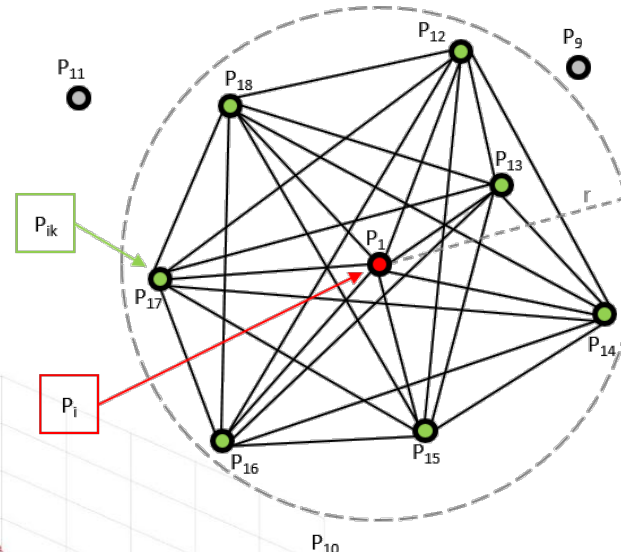
# 3 Test experiment – simulation of a landslide

## ■ Deformation Analysis

Point Feature Histogram (PFH)



shows the  
changes by vectors



**3D Feature-based methods  
(with descriptors)**  
defining features e.g. neighborhood  
relations of points in terms of distance and  
orientation

**No clear statement,  
not satisfactory right now!**

- promising approach
- results need to be controlled and parameters adjusted

outlook: laboratory test with deformations  
that are known

Thank you  
for your interest!

# Big picture



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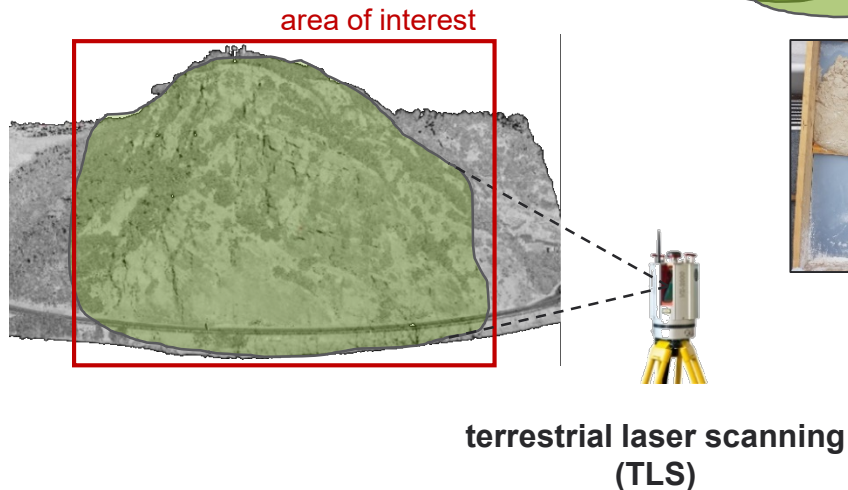


## Object recording

## Simulation

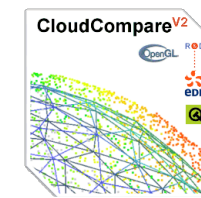
## Deformation Analysis

## Outlook



### Area-base methods

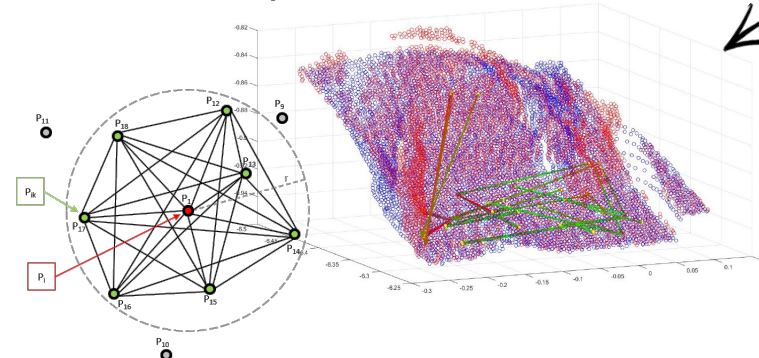
Cloud Compare



Source: <https://www.danielgm.net/cc/>

### 3D Feature-base methods

Descriptors



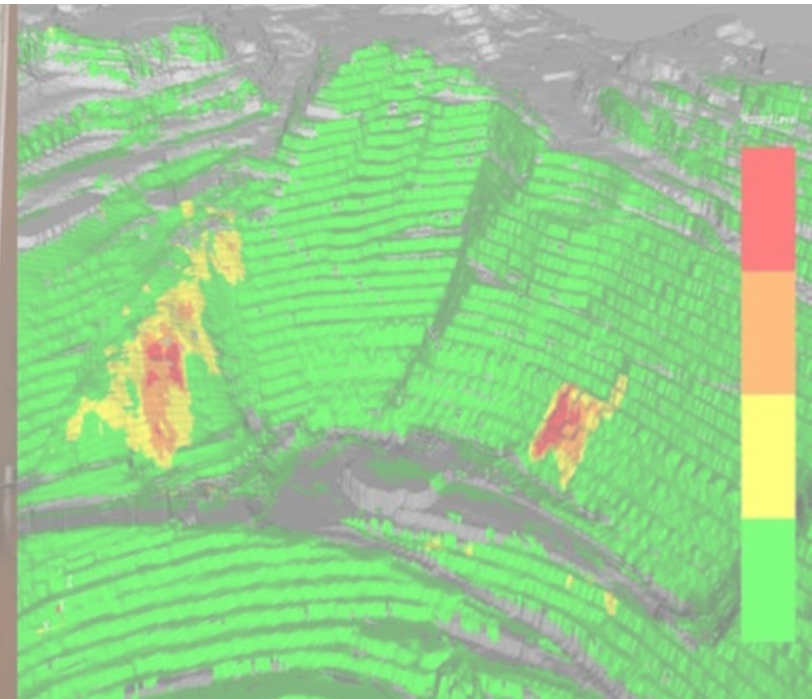
laboratory  
tests with  
target  
deformations

control  
adjustment  
new  
approaches



# LIDAR MONITORING

Automated monitoring for risk management in mining, infrastructure and natural hazards



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+49 201 172 1856

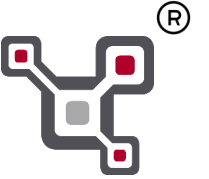


DMT Civil & Mining Engineering



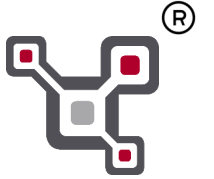
**DMT SAFEGUARD**

*LIDAR*



# DMT SAFEGUARD LIDAR RESEARCH & DEVELOPMENT

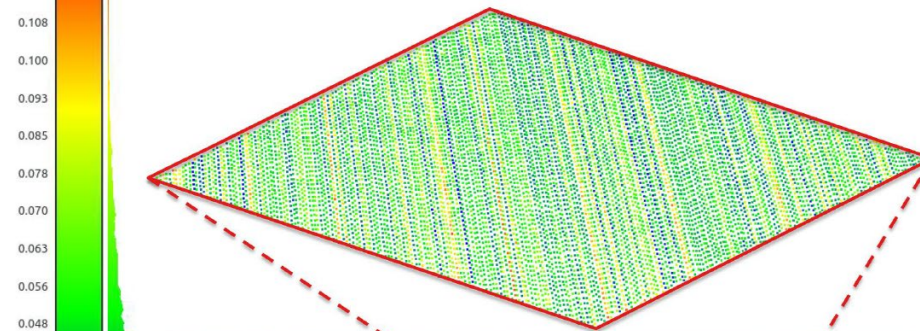


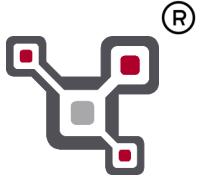


- ENVIRONMENTAL INFLUENCES ON THE STABILITY OF A PERMANENTLY INSTALLED LASER SCANNER (ISPRS: M. Kuschnerus, D. Schröder & R. Lindenbergh)

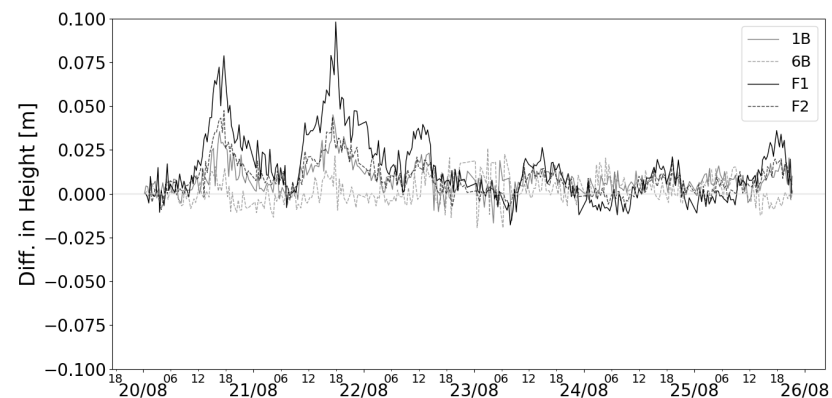
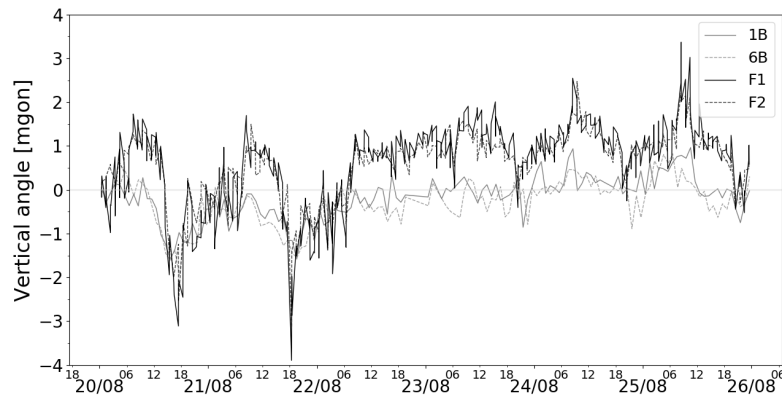
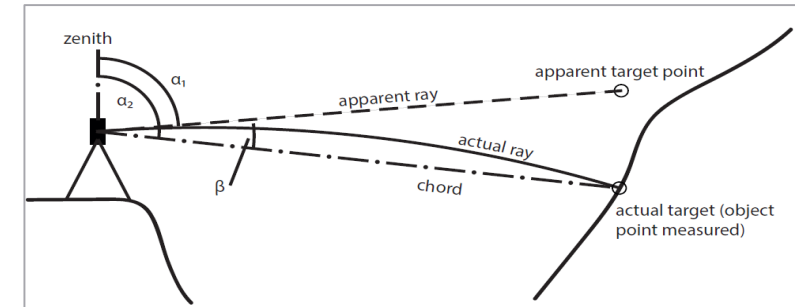
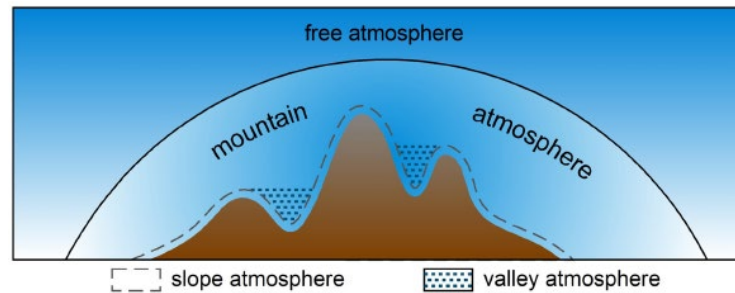
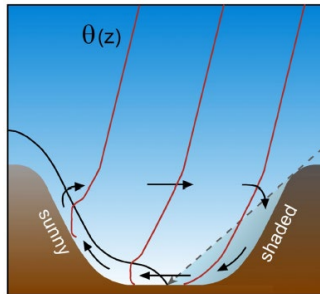
### Effect of Storms on PLS Stability

cloud to cloud distance [m]: stormy day February 2020 09:00 and 10:00  
(wind speed 16.5 m/s)





- Die Atmosphäre als restriktiver Einfluss auf Messergebnisse eines Long Range Laserscanners (Geodätische Woche Obergurgl: D. Schröder & A. Nowacki)



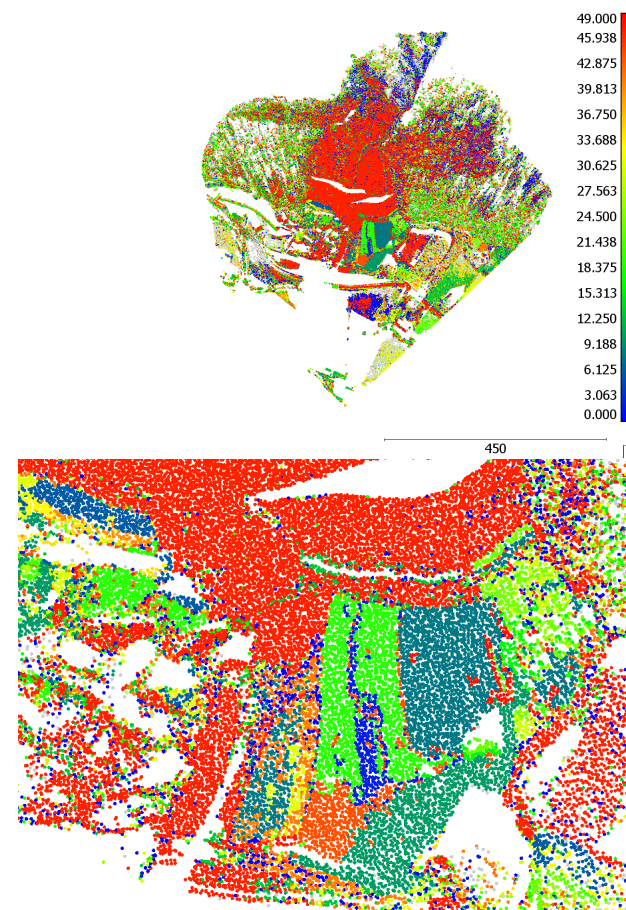
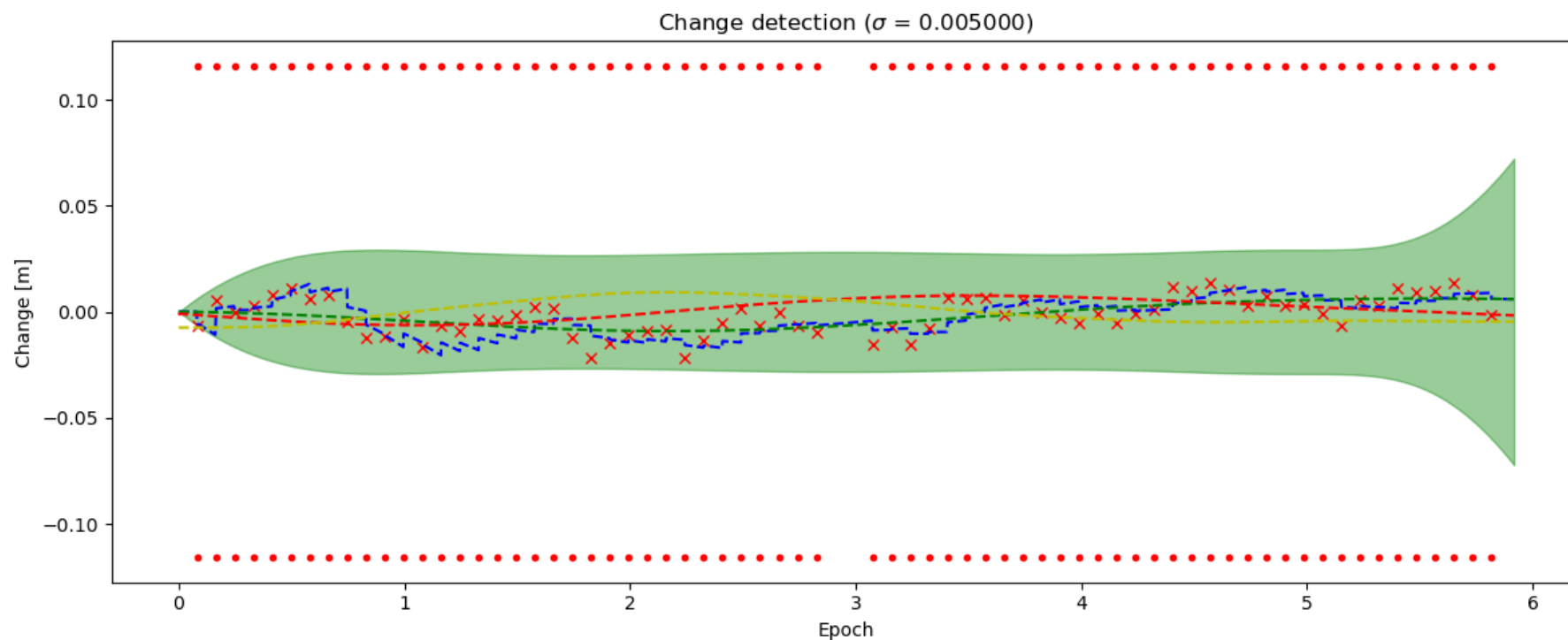


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## ■ 4D Topographic Point Cloud Change Analysis using Kalman Filters (L. Winiwarter / Uni Heidelberg)

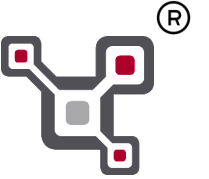




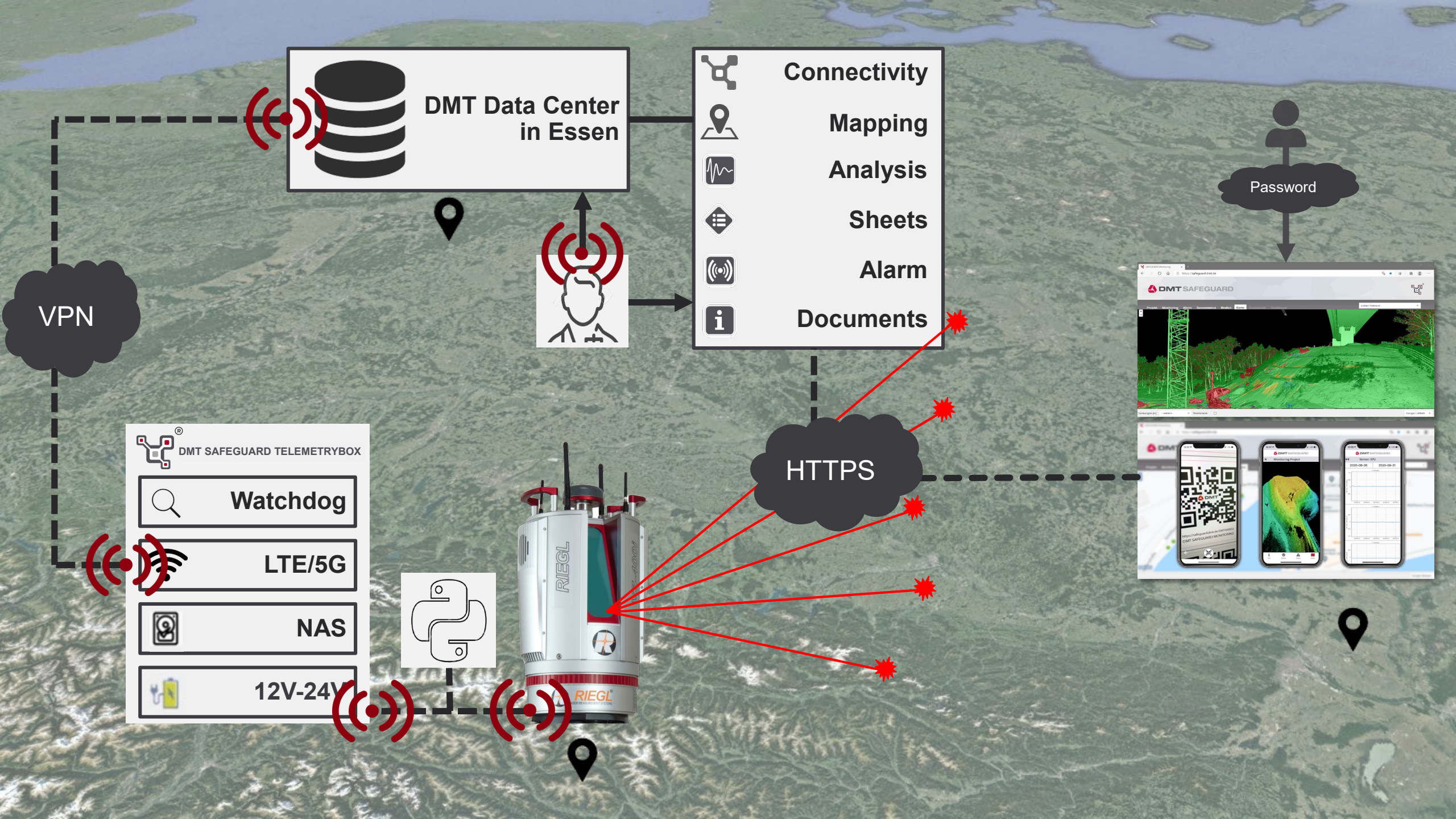


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# DMT SAFEGUARD LIDAR INTEGRATION & SERVICE

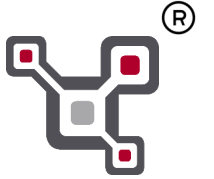






# DMT SAFEGUARD

## LIDAR



### Essen (DMT)



Connectivity



Mapping



Analysis



Sheets



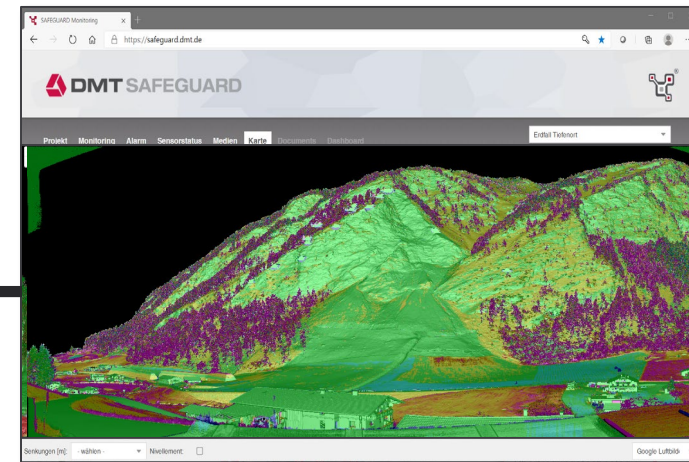
Alarm



Documents

Realtime (Automated)

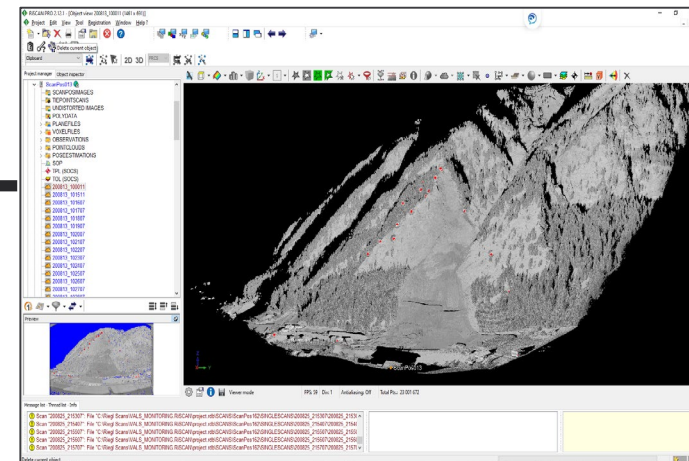
Postprocessing



Monitoring App

SlopeAngle App

DesignComp App



Deformation Analysis

Geological Mapping

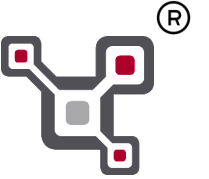
Volume Calculation





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# Application I

Vals (Tyrol) – Rockfall



Web View Monitoring

Project monitoring\_landslide

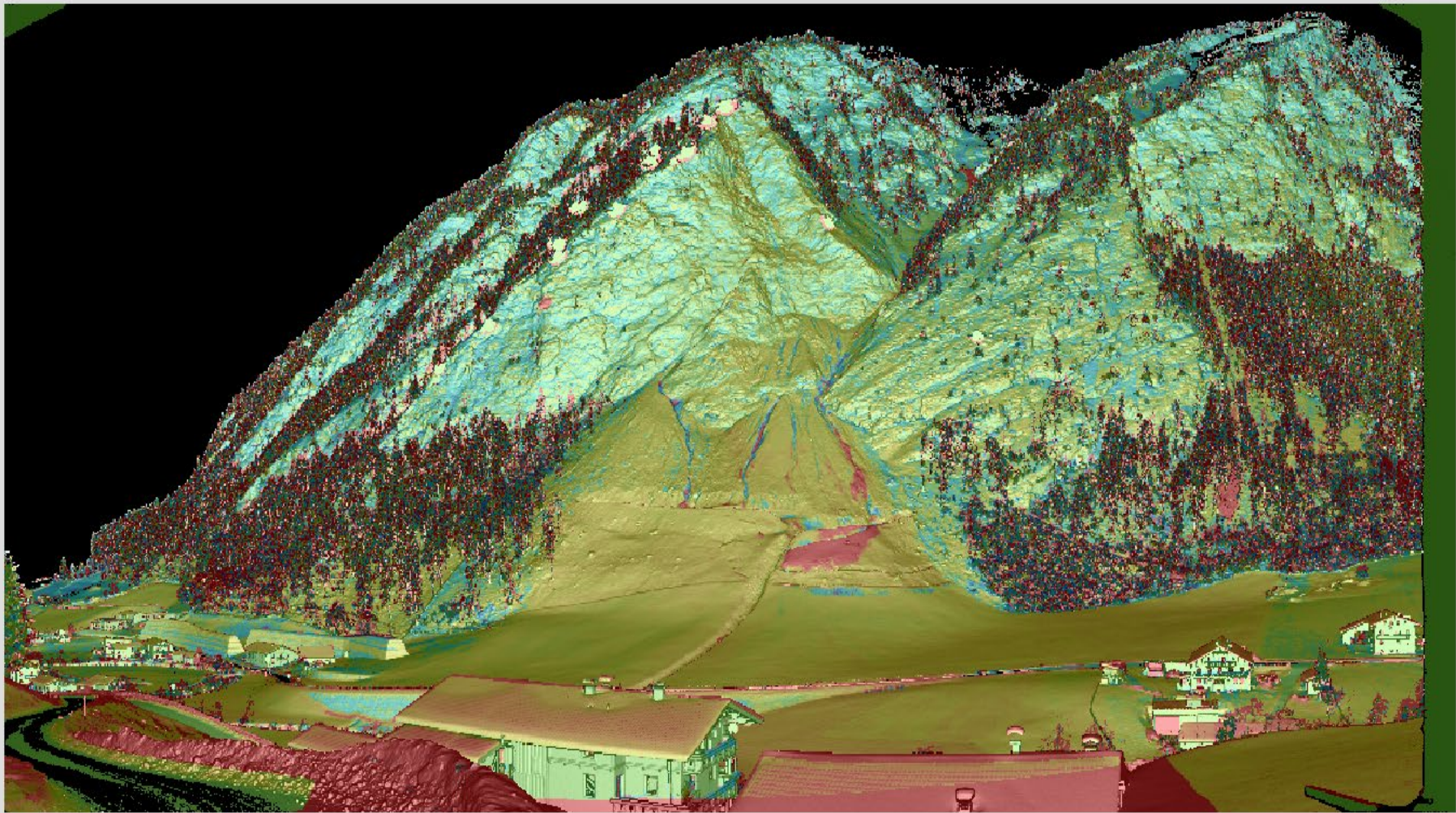
Position ScanPos001



About

+

-



Reference



30.07.2021  
06:00:11

Compare



01.12.2021  
09:00:34

Scanner Orientation Adjustment

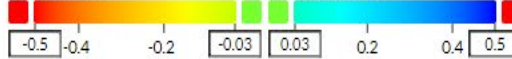
Every 1 scan

Appearance

Show shaded

Overlay

Closer-By (m):



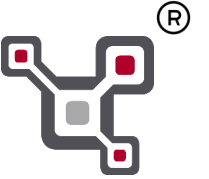
clear threshold colors

Opacity: 33%



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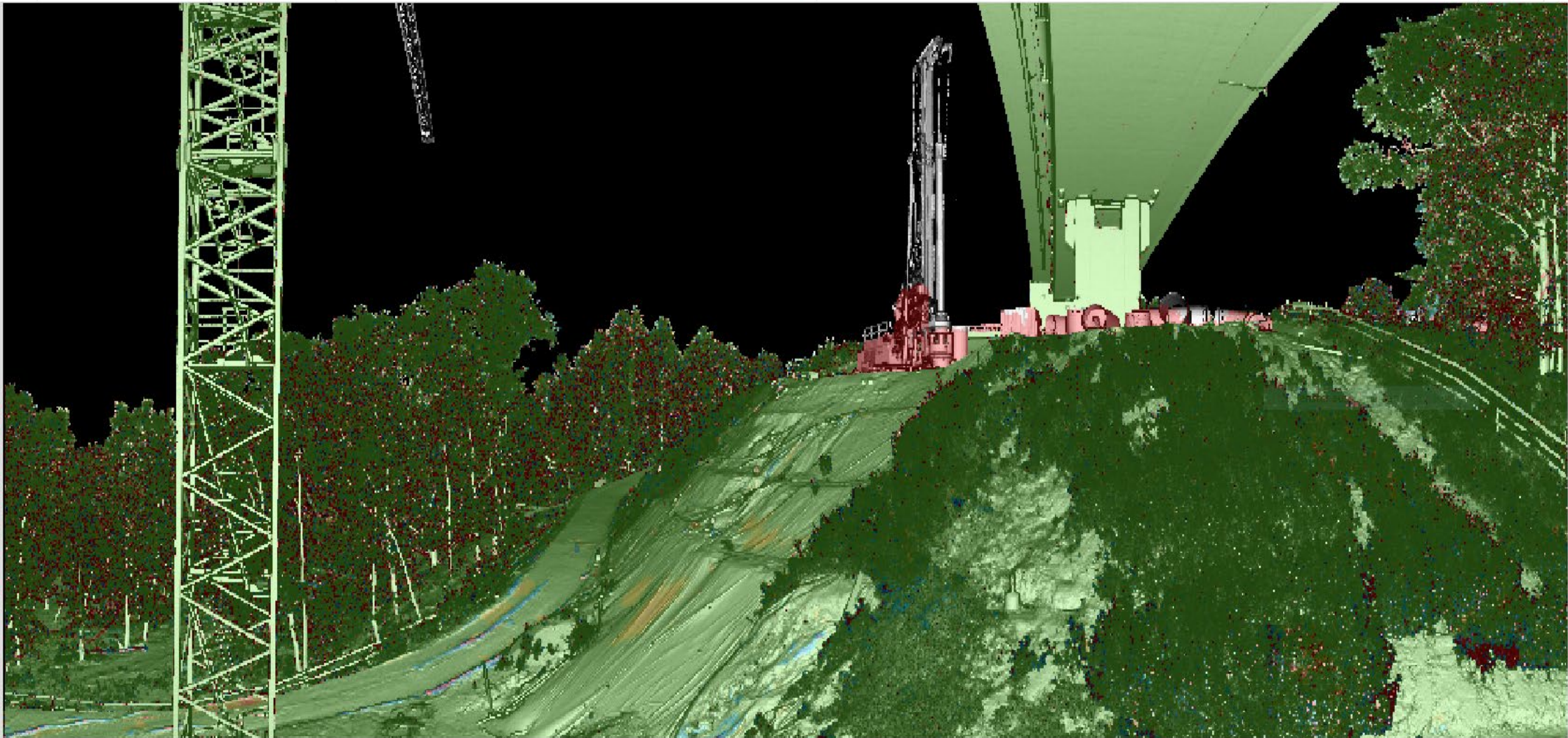
*LIDAR*



# Application II

## Infrastructure





Reference



03.08.2021  
22:30:16

Compare



14.08.2021  
10:30:16

Every  scan

Appearance

☒ Show shaded

Overlay ☒

Closer-By (m):

Further Away (m):

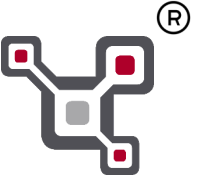
clear threshold colors

Opacity:



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# Application III

## Mining





Web View  
Monitoring



Project  
LEAG\_MON\_APP



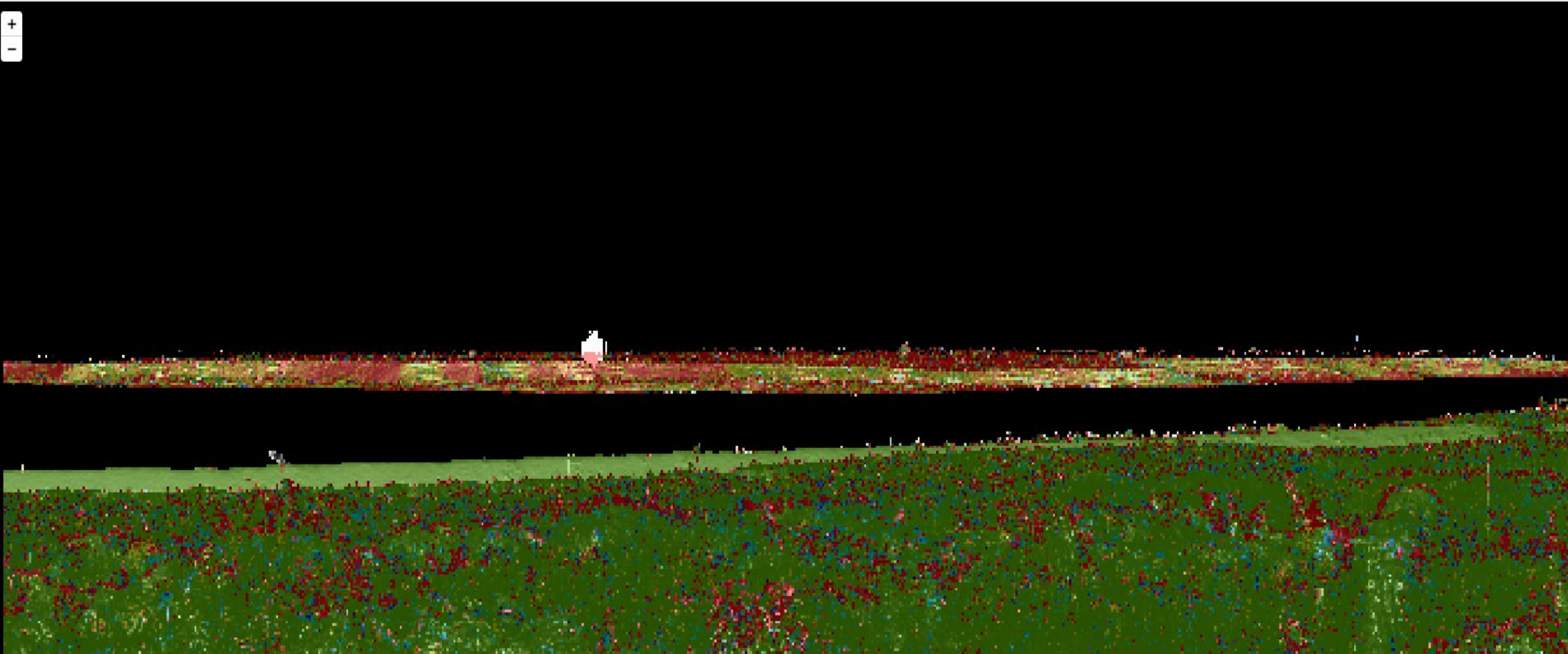
Position  
ScanPos001



About

+

-



Reference

13.07.2021

10:00:20

Compare

22.07.2021

13:00:29

Every 1 scan



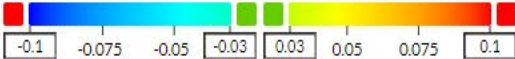
Appearance

☒ Show shaded

Overlay

☒

Closer-By (m):



Further Away (m):

[clear threshold colors](#)

Opacity:

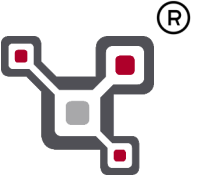






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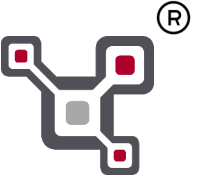


# Summary



**DMT SAFEGUARD**

*LIDAR*



- **SAFEGUARD can fully integrate the LIDAR system!**
- **Multisensory platform without additional software**
- **Experts support customers in quality-assured integration into their risk management, taking into account standard guidelines**
- **The client receives quality-assured data and expertise, not just data acquisition**
- **System is ready to use and marketable!**