



# Trains & Drones - SBB ist taking to the air

SSPRS - Swiss Society for  
Photogrammetry and Remote Sensing

Nicolas Ackermann (SBB CoC Drones)

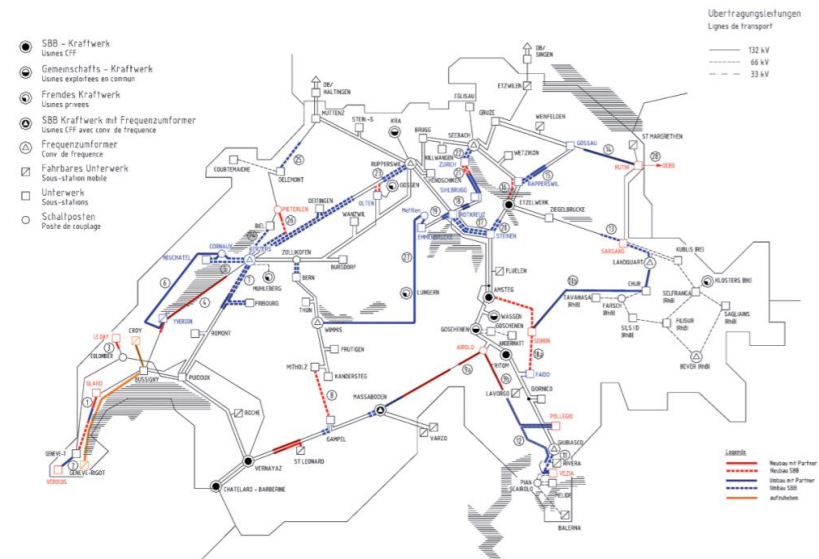
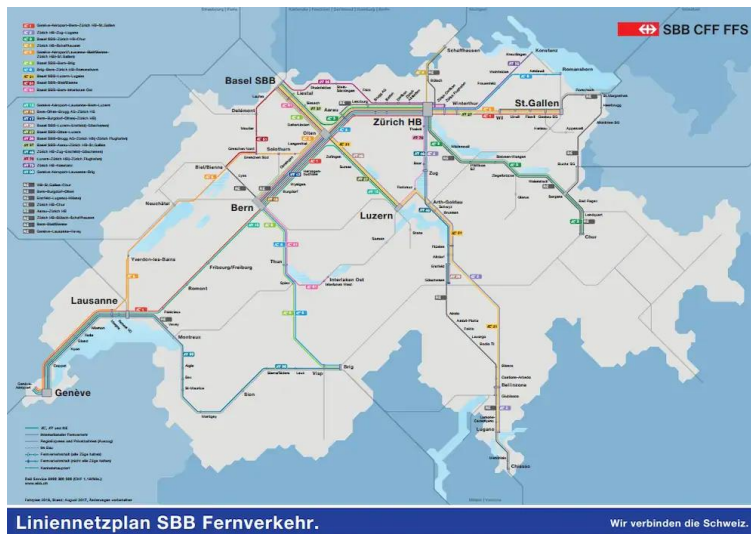
5.11.2020





# Swiss Federal Railways

- The Swiss Federal Railways (SBB) has one of the most heavily used railway networks in the world.
- 10,000 trains transport 1.18 million passengers and 210,000 tons of cargo over 3000 kilometers of railways each day.
- 6000 bridges, 800 tunnels, 25'000 retaining walls.



SBB's rail (left) and energy (right) networks

# SBB Center of Competence Drones



Stefan Koller



Nicolas Ackermann



Bruno Hauser



Andreas Hoffmann

New website: <https://www.sbb.ch/drones>

# Tasks and objectives of CoC Drones



**Networking and know-how**  
Networks of experts, business opportunities and technology, expert know-how



**Standardised service and framework conditions**  
Training, consultancy, laws, framework conditions



**Developing fields of application**  
Monitoring channels, energy efficiency, inspecting bridges, etc.



**Standardised processes, tools and technologies**  
Analyses, assessments, quality assurance



**Exploring potential**  
Increasing efficiency and quality



**Operationalisation**  
Enabler and catalyst for the area

# Roadmap

**Short term**  
2018

**Medium term**  
2019-2021

**Long term**  
2022-2025



## Manual analysis

Monitoring channels  
Incident management  
Inspecting dangerous goods



## Automated analysis

Inspecting bridges  
Monitoring slopes  
Neophyte mapping

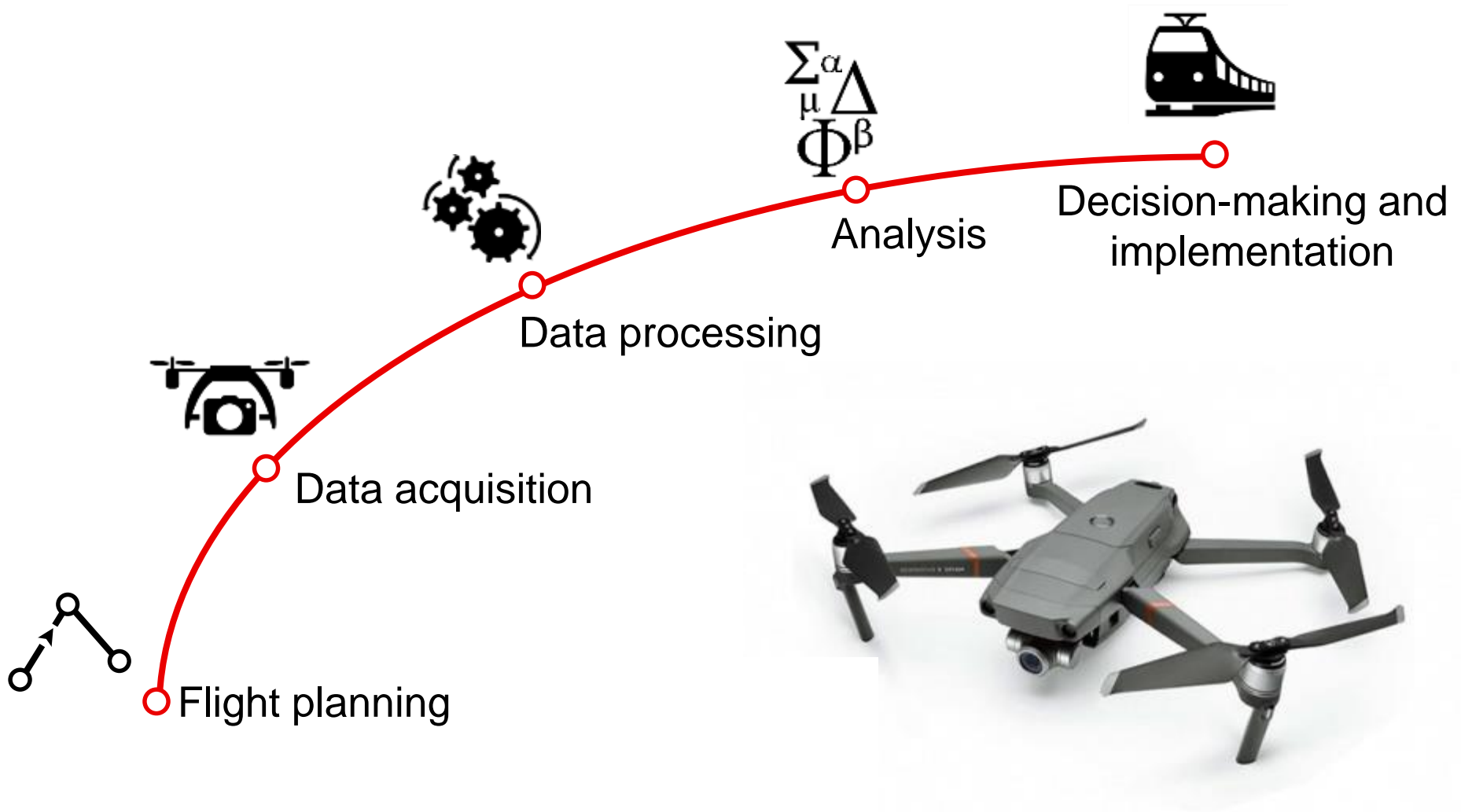


## Autonomous systems

Automated inspections  
Long endurance drone  
Drone box

Technology application

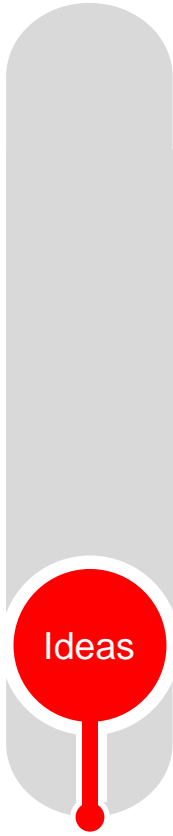
# Tool chain



# Overview of intended applications



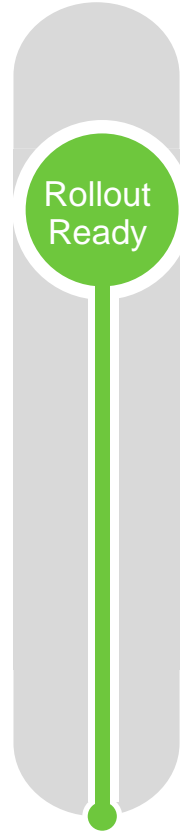
- Retaining wall
- Inspecting storage dams
- High voltage lines
- Inspecting contact lines
- Inspecting masts
- Embankment moisture content
- Building documentation
- Indoor inventory
- Inspecting roofs
- Manholes inspection
- Routing of tracks
- Landcover mapping



- Neophytes mapping
- Forest vitality mapping
- Vegetation mapping
- Infrastructure document.
- Railway track inspection
- Cable duct inspection
- Slope monitoring
- Training
- Inspecting earthwork struct.
- Drone box
- Long distance drone
- Inspecting platform roofs
- Graffiti prevention
- Clearance gauge
- Track topology extraction



- Water level of dam lake
- Monitoring channels
- Culverts inspections
- Incident management
- Construction site monitoring
- Bridges inspection
- Dangerous goods inspection
- Site surveys



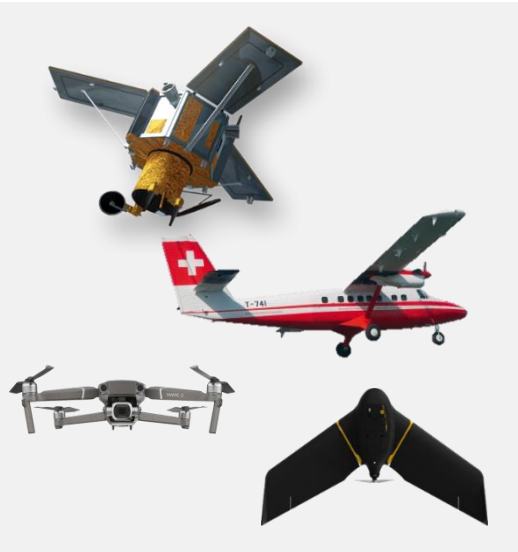
# Technology

RGBI

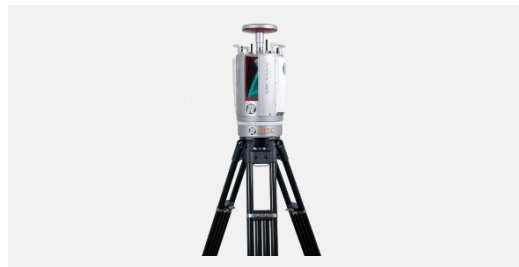
LiDAR

InSAR

Airborne/ Spaceborne



Terrestrial



Point cloud  
DGM/DOM  
Orthophotos  
3D models

Point cloud  
DGM/DOM  
3D models

Displacement measurements





# Application examples

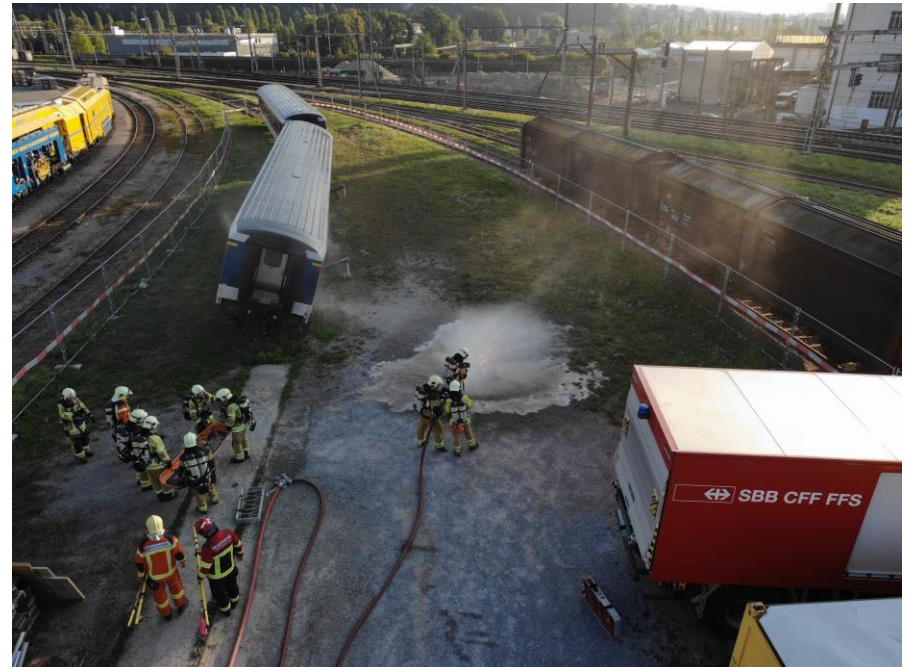
# Incident management

## → Goal

- Livestream for operations management / staff / control centre
- Documentation support (prior and post intervention)

## → Technology

- Drones equipped with RGB and TIR cameras
- Livestream software



SBB Intervention training in Olten

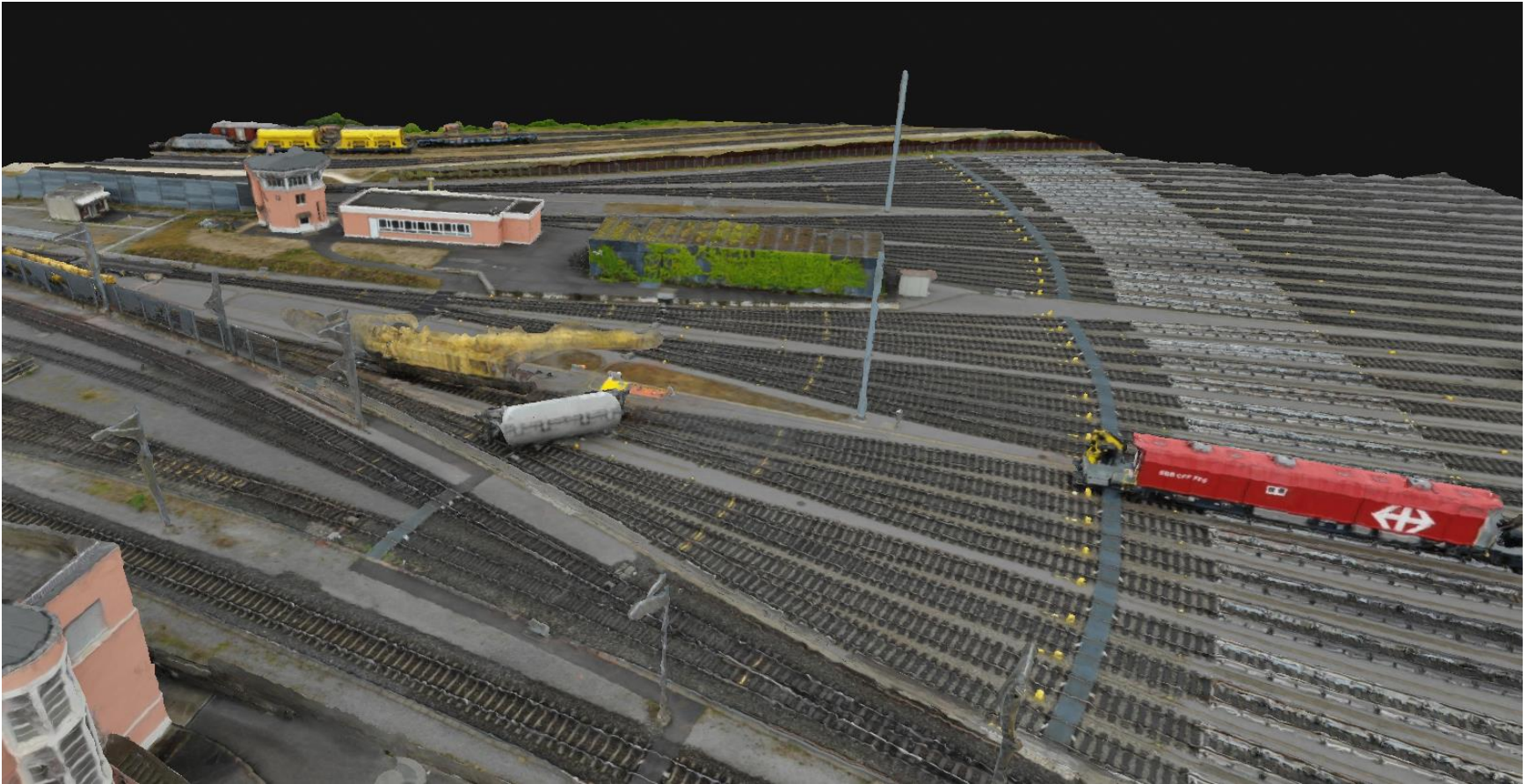
# Incident management



Livestream thermal images during training in Olten



# Incident management



Documentation freight vehicle derailment



# Monitoring slopes

## → Goal

- Displacement measures for monitoring slopes and rockcliffs
- Documentation / Visualisation

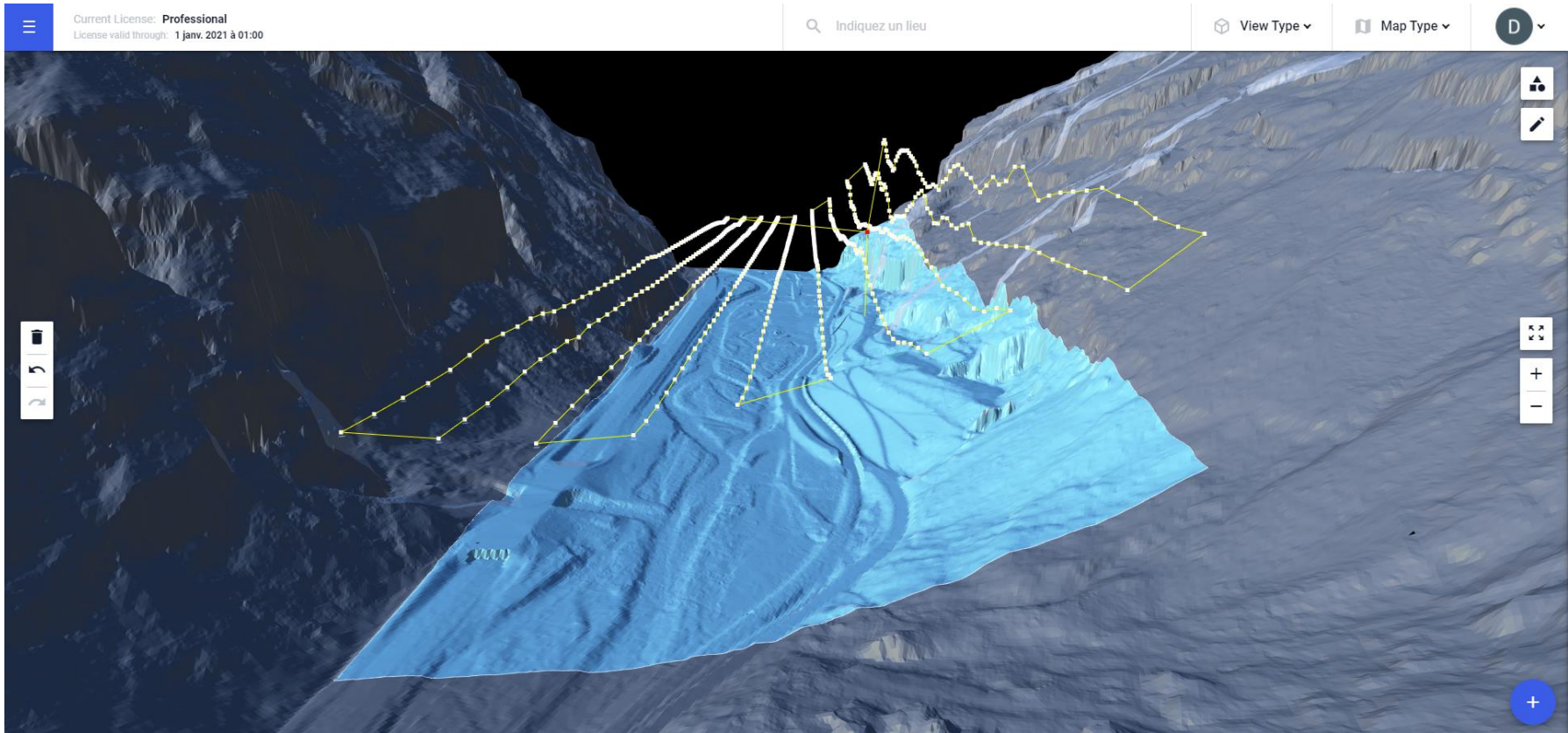
## → Technology

- Drones equipped with RGB cameras and LiDAR
- InSAR satellite data



Safety nets in Axenflue

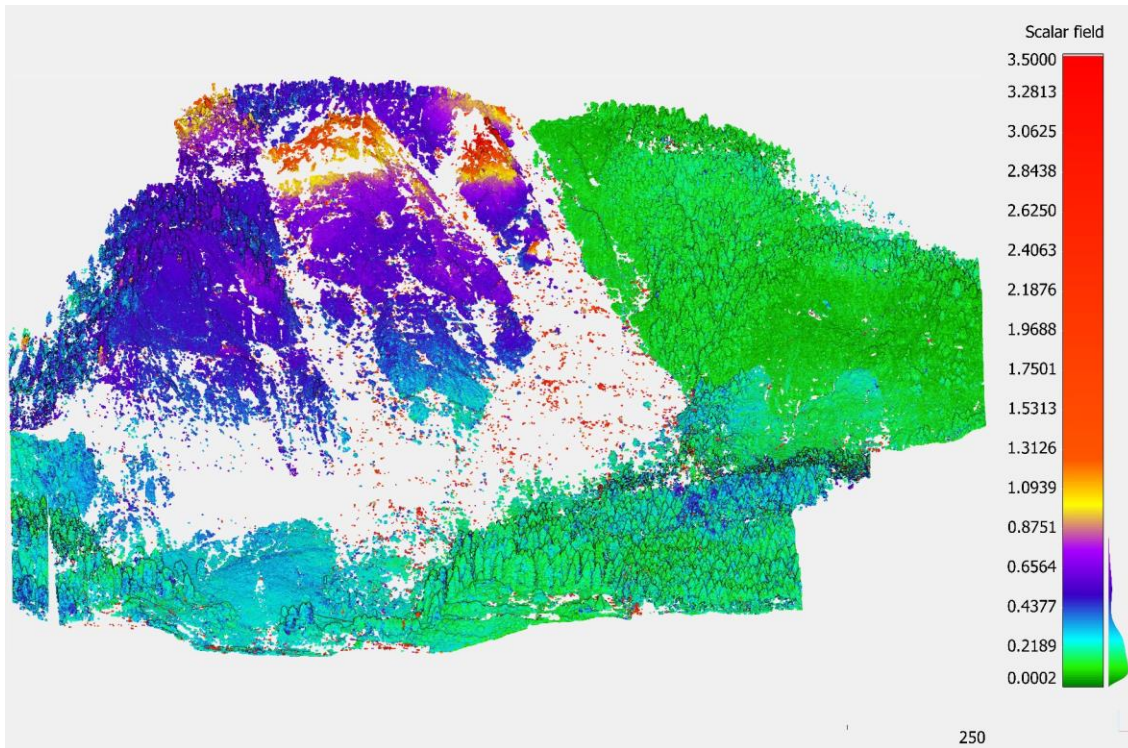
# Monitoring slopes



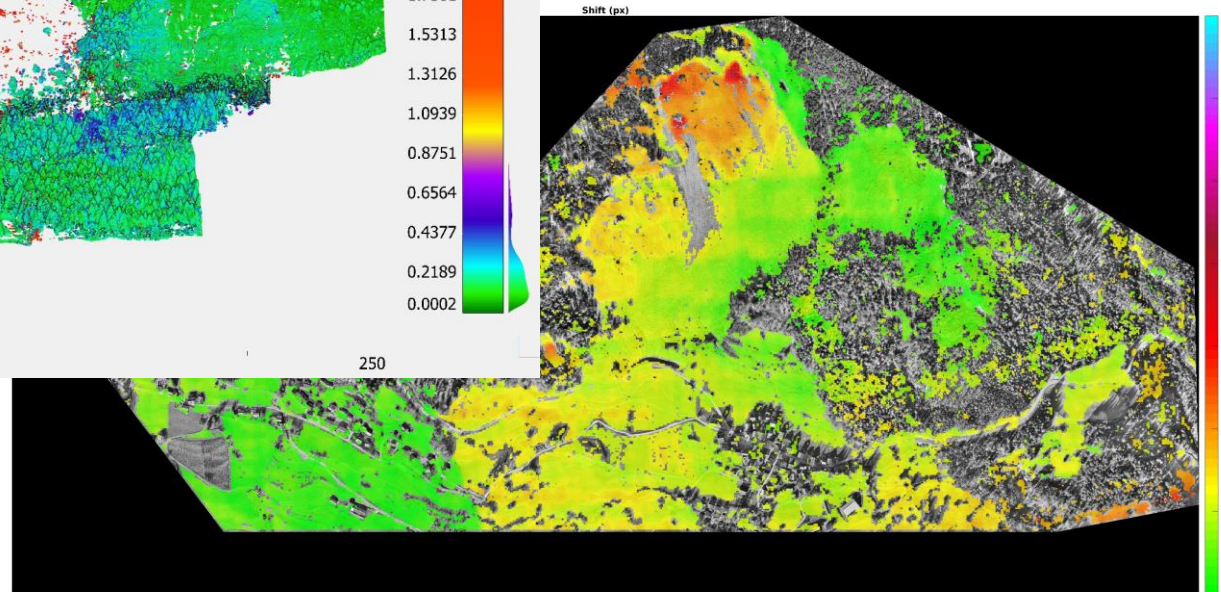
Flight planning with DEM in Tessin for mapping a landfill site



# Monitoring slopes



Displacements LiDAR



Displacements RGB camera

# Monitoring slopes



Visualisation for planning for example the construction of safety nets.



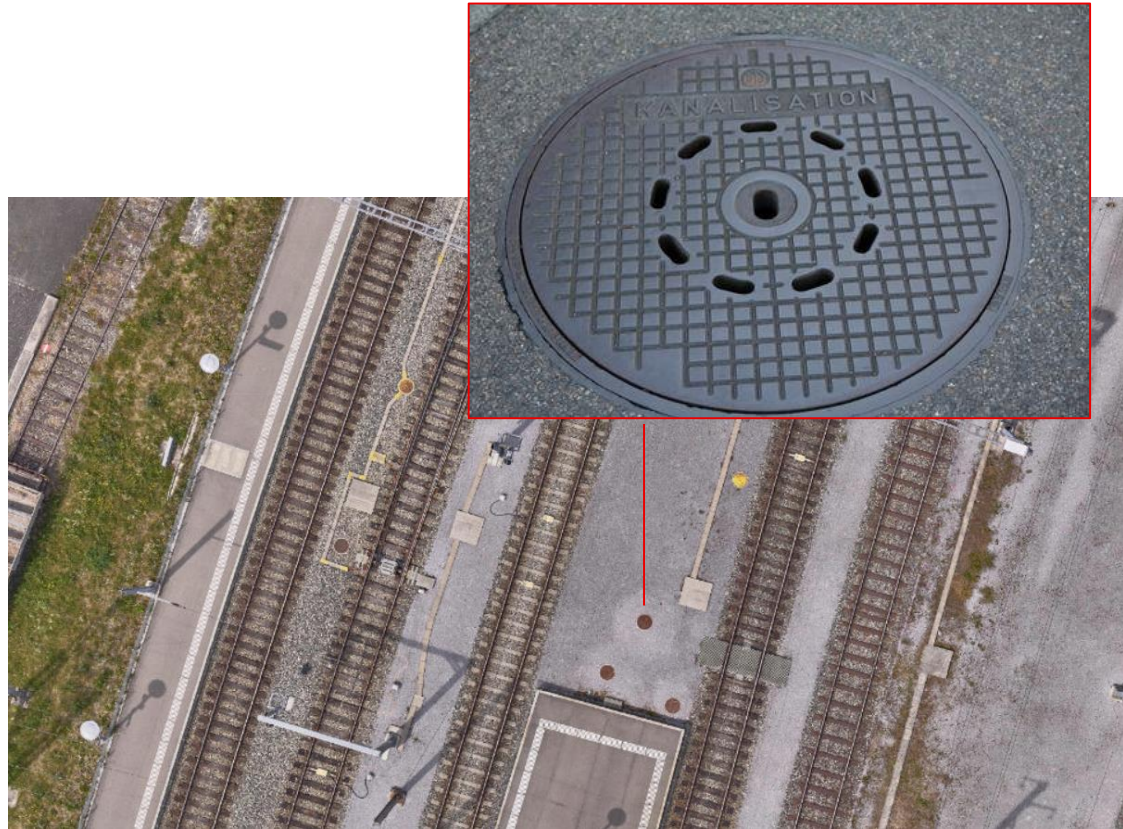
# Infrastructure documentation

## → Goal

- Update (semi-) automatically the SBB Infrastructure Database

## → Technology

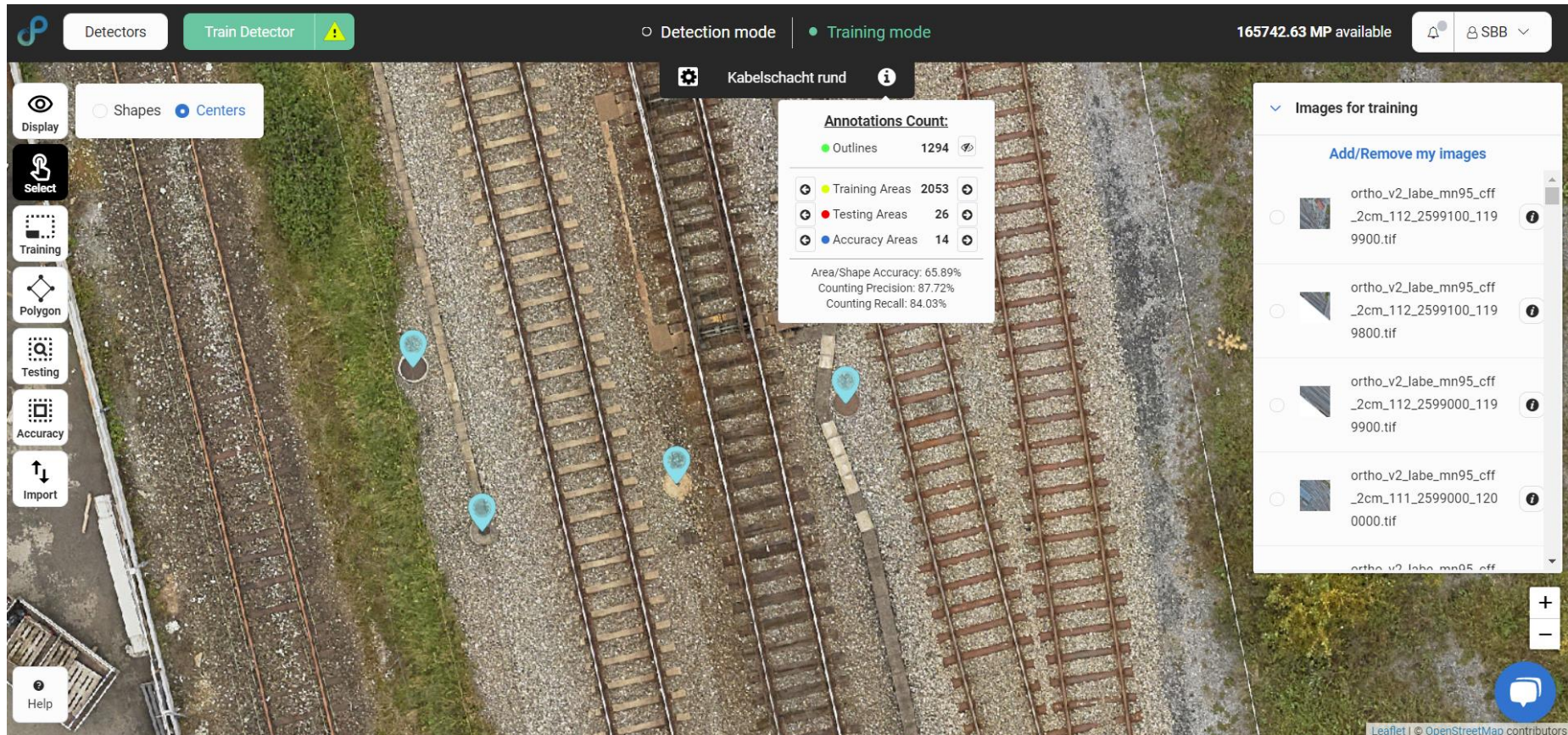
- Drones and manned Helicopters equipped with RGB cameras and LiDAR



Example of railway infrastructure



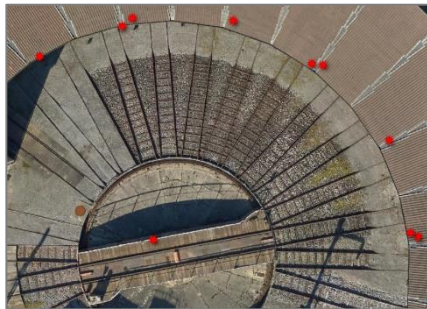
# Infrastructure documentation



Example of detected manholes on a cloud-based Plattform

# Infrastructure documentation

→ Results: comparison with SBB Database (preliminary results)



|                        | Manholes provided in SBB Database | Manholes not provided in SBB Database | Total      |
|------------------------|-----------------------------------|---------------------------------------|------------|
| Correctly detected     | 250 (46%)                         | 1 (2%)                                | <b>251</b> |
| Not correctly detected | 292 (54%)                         | 57 (98%)                              | <b>349</b> |
| Total                  | <b>542 (100%)</b>                 | <b>58 (100%)</b>                      | <b>600</b> |

Accuracy matrix



# Vegetations mapping

## → Goal

- Automatic vegetation mapping and treating using Hot Water Spraying Vehicles

## → Technology

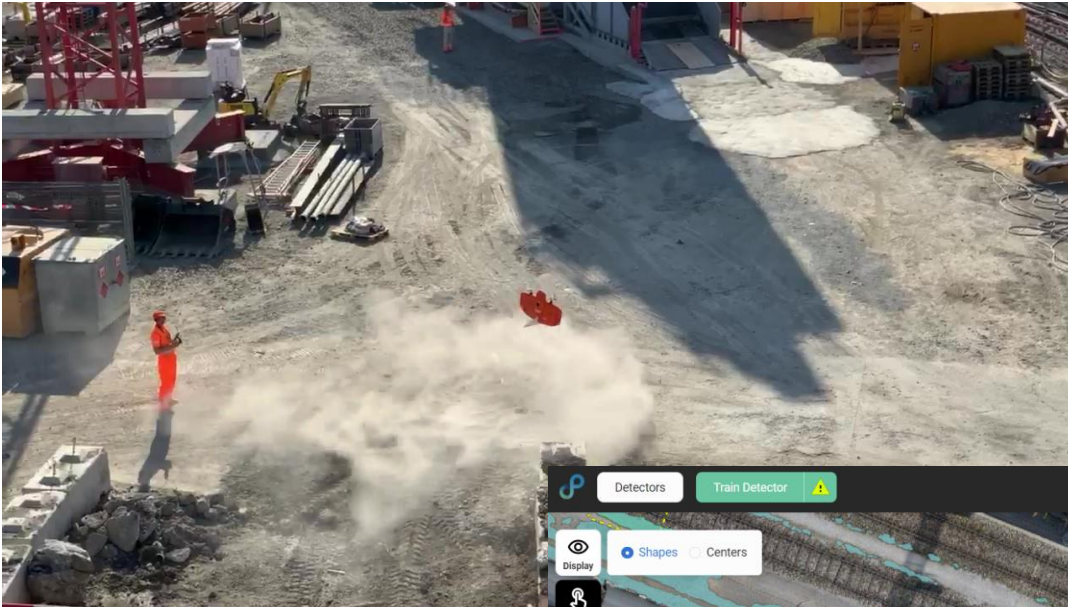
- Drones and manned Helicopters equipped with RGB IR cameras



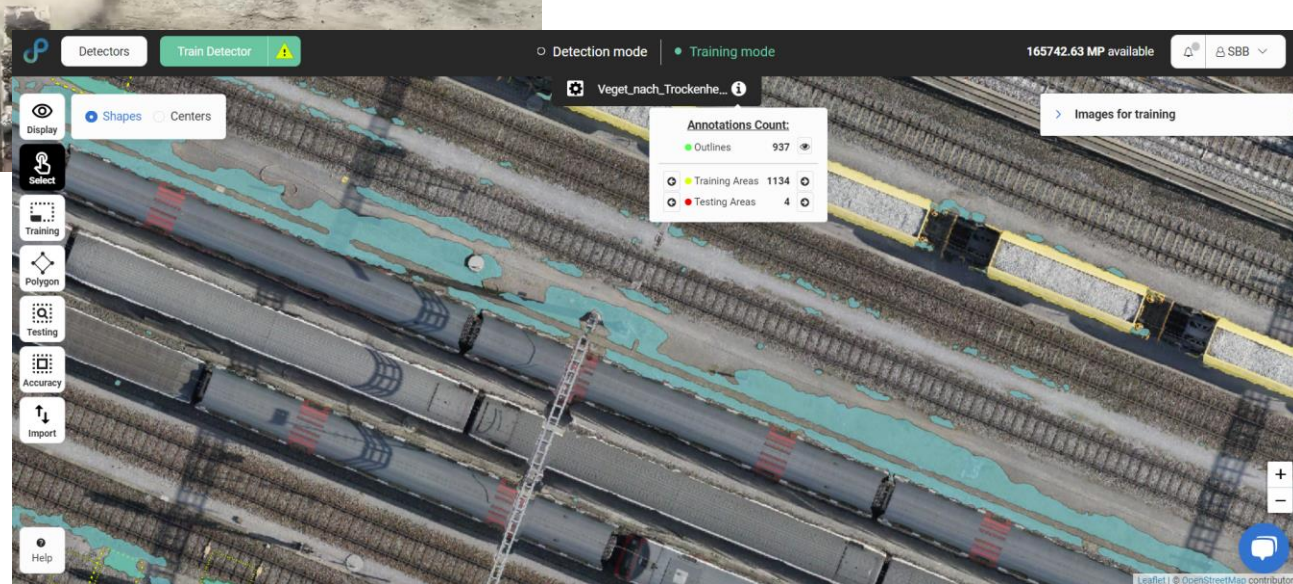
SBB Hot Water Spraying Vehicles



# Vegetations mapping



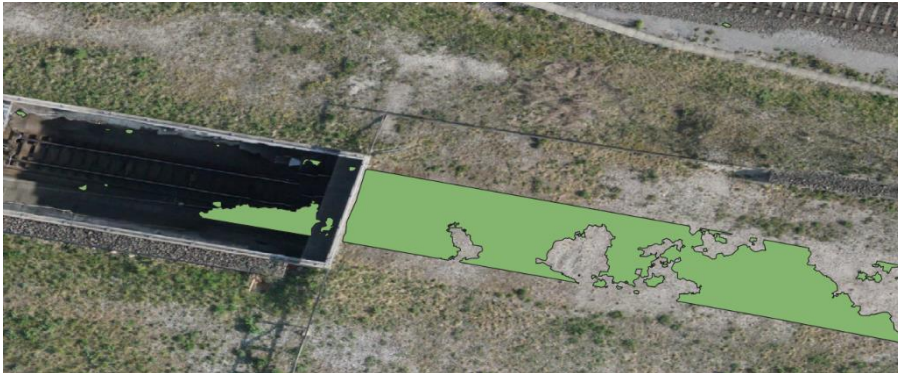
VTOL fixed-wing UAVs are well suited to data acquisition of large areas in a railway environment.



Vegetation mapping based on AI

# Vegetations mapping

→ Results: visual observations (preliminary results)



Detection over tunnels must be filtered out



Water underneath railway tracks can potentially be inferred



# Inspection of culverts

## → Goals

- Know the condition of culverts and avoid possible flooding and damage to railway installations

## → Technology

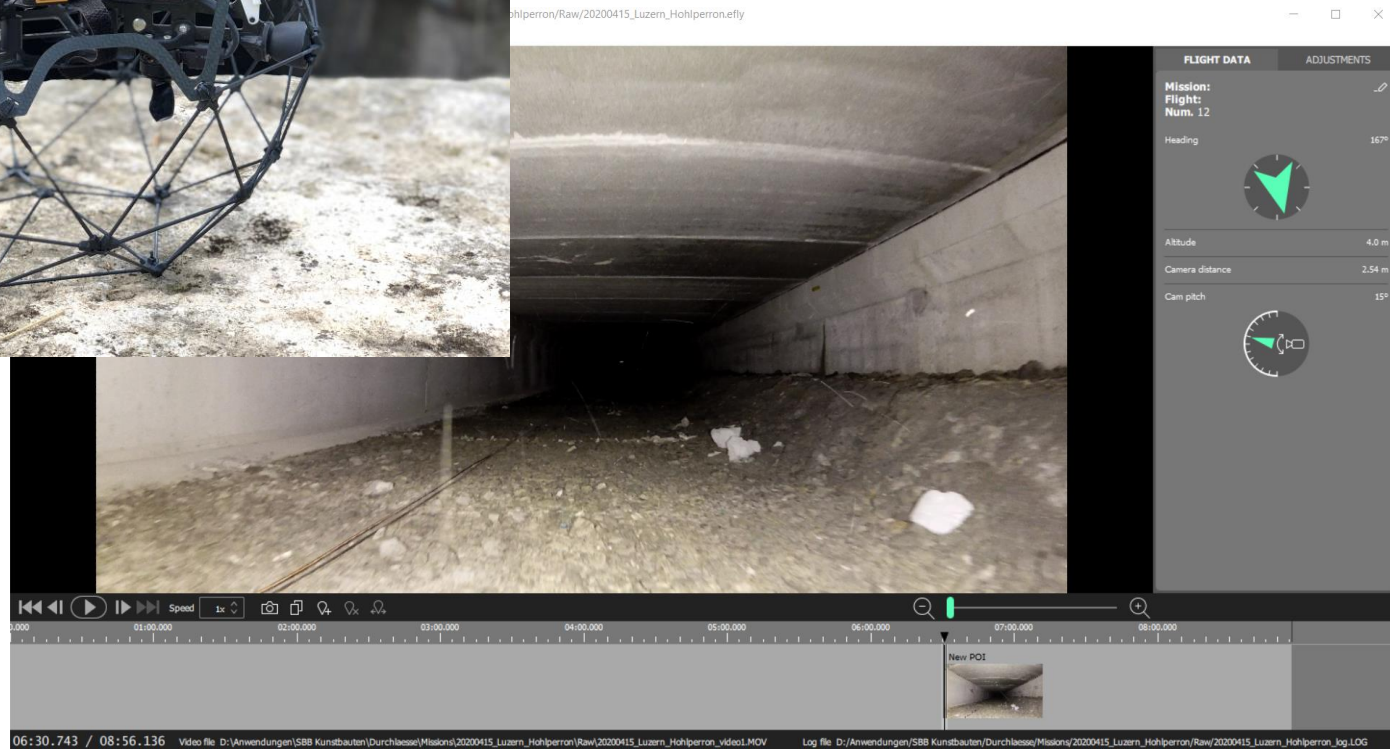
- Collision-tolerant drone equipped of RGB TIR camera



# Inspection of culverts



Collision-tolerant drone





Many thanks.