ITC / EOS

AIRBORNE LASER SCANNING IN GNSS-DENIED AREAS

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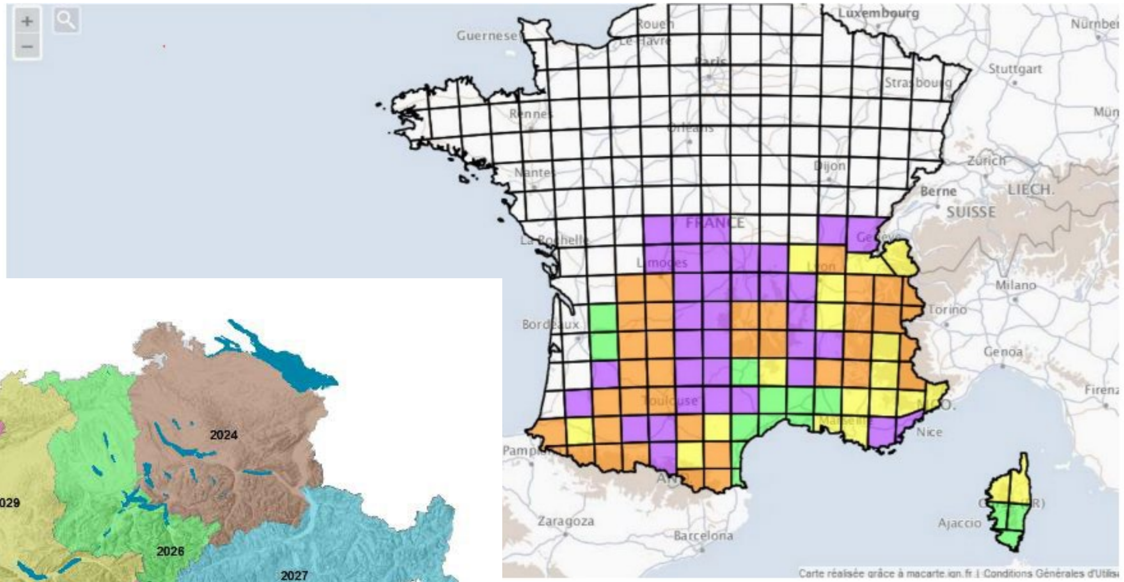
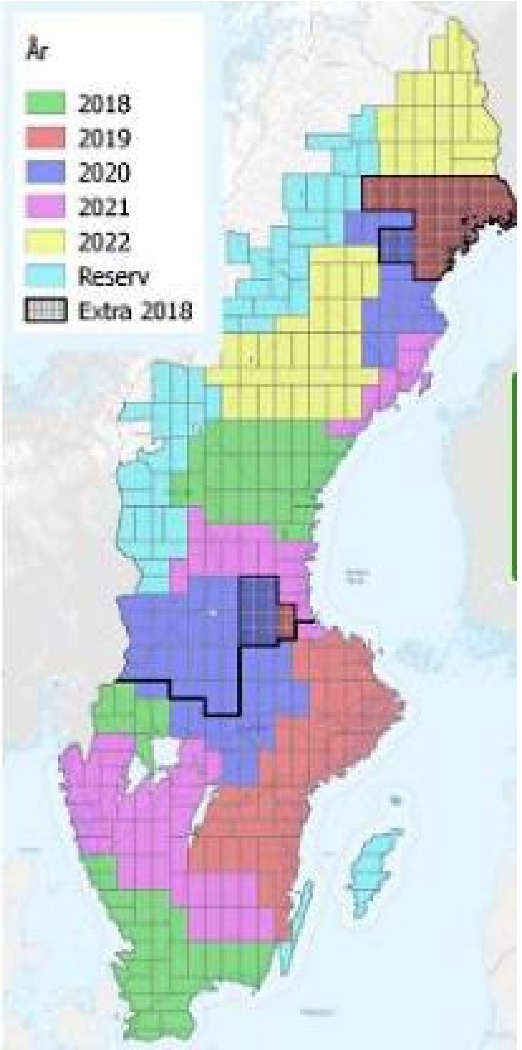
AIRBORNE LASER SCANNING IN EUROPE

Many countries have multi-annual plans to survey their entire area

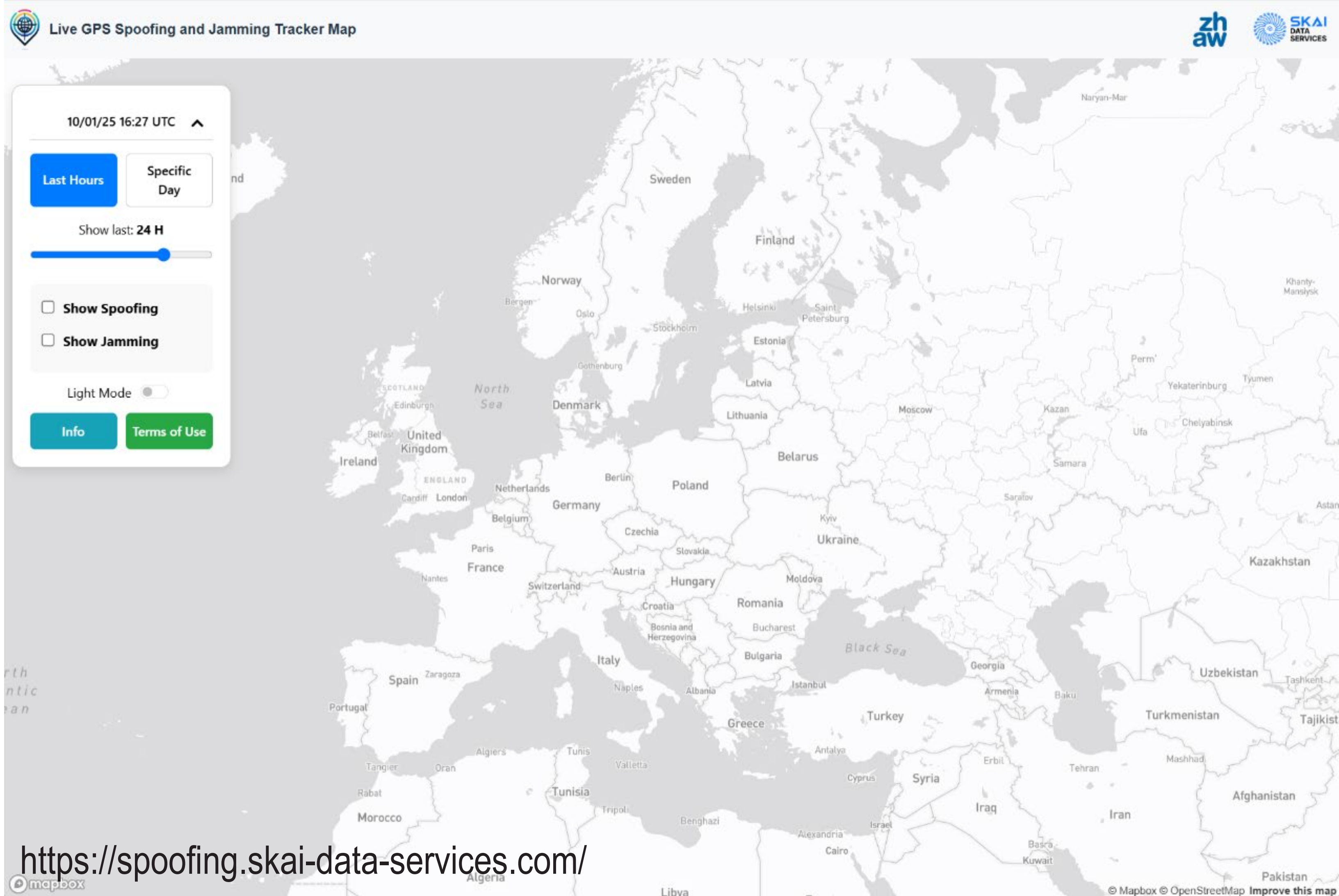




NO AIRBORNE LASER SCANNING NEAR CONFLICT ZONES

Last EuroSDR meeting:
Cyprus is unable to use airborne laser scanning for 1.5 years

Reason:
GNSS jamming and spoofing to disable GNSS use near conflict zones



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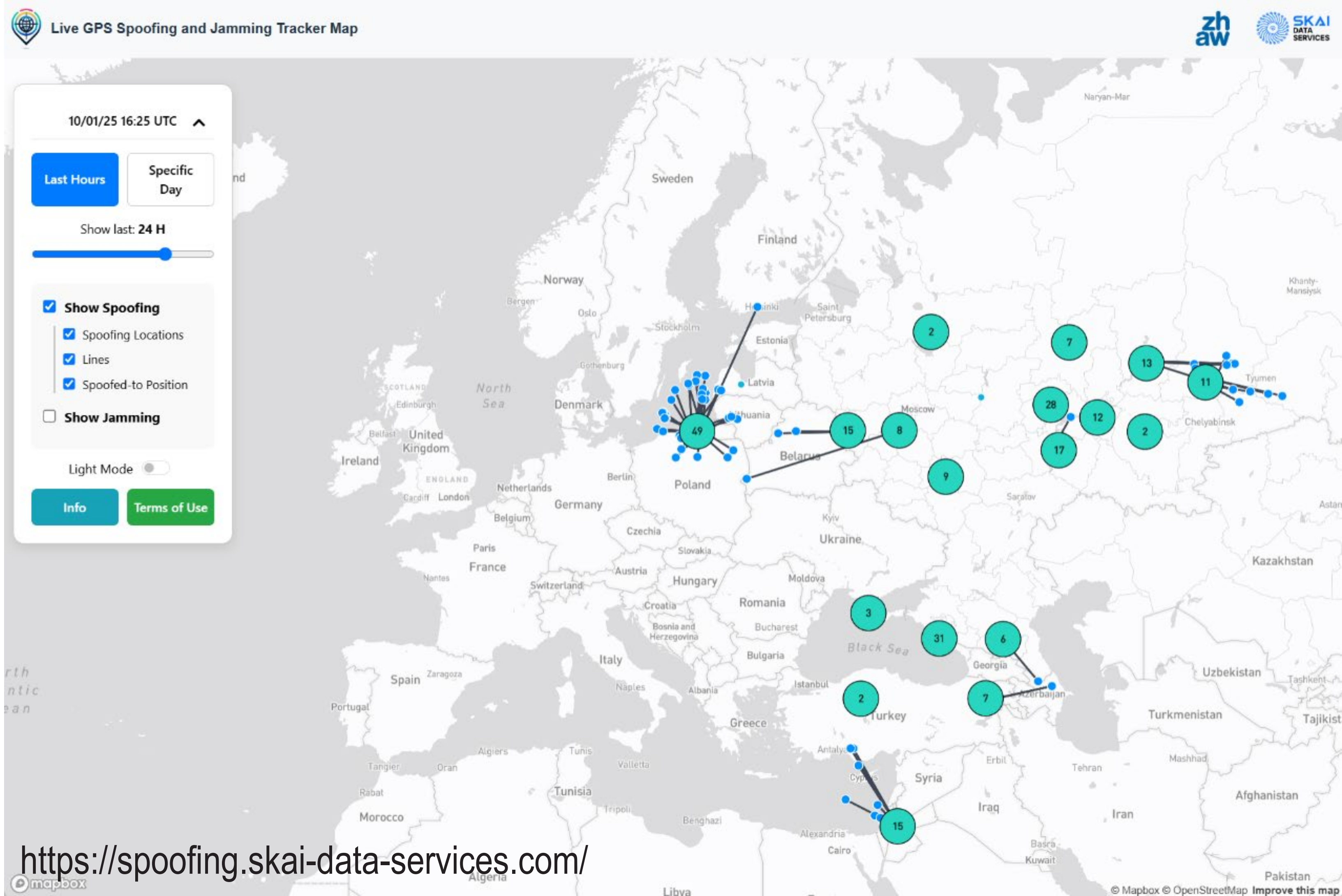
Spoofing:
emission of fake GNSS signals



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Spoofing:
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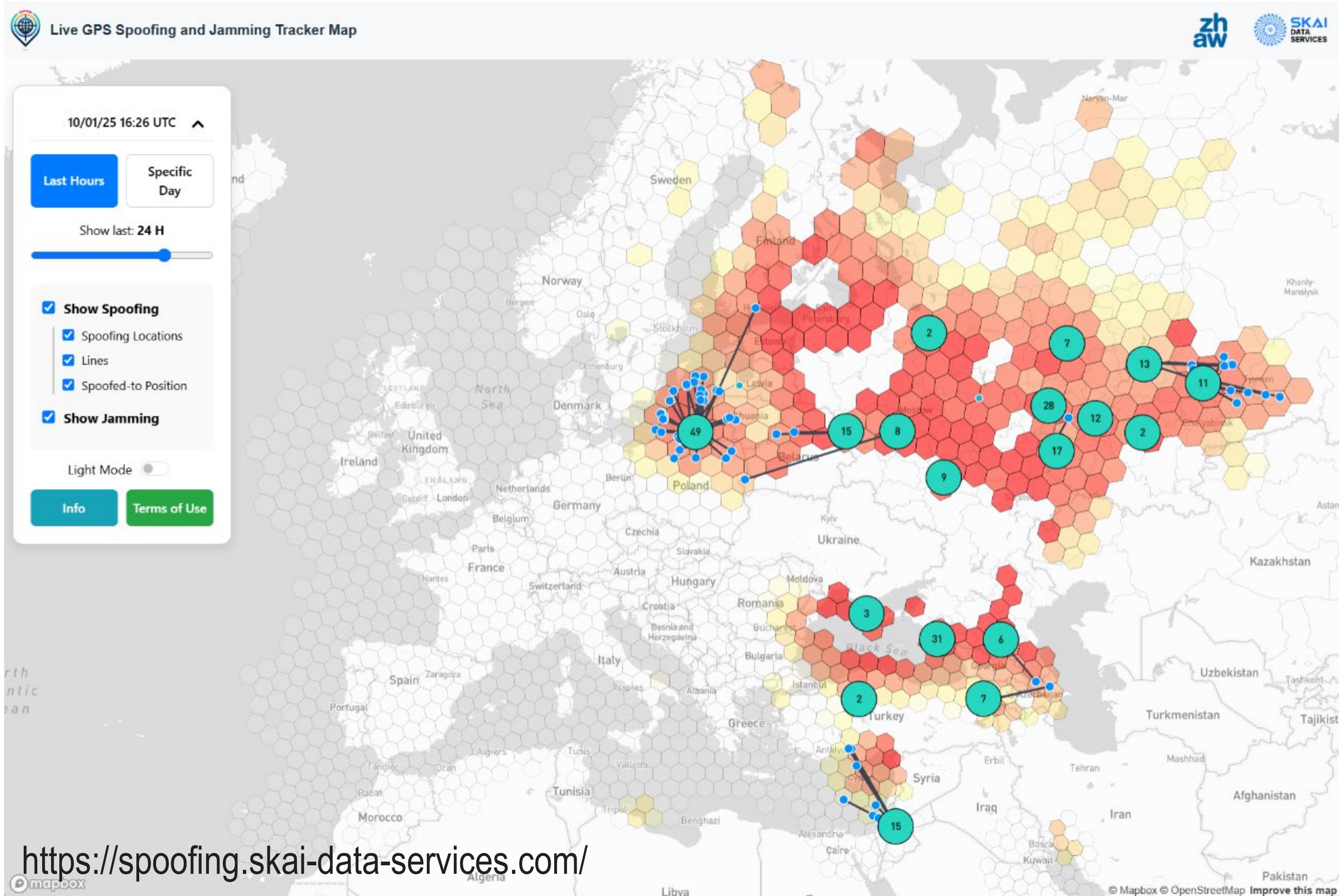
Jamming:
Emission of a strong signal at the GNSS frequencies

Affected: Cyprus, Finland, Poland, Estonia, Latvia, Lithuania, Moldova, Romania, Bulgaria



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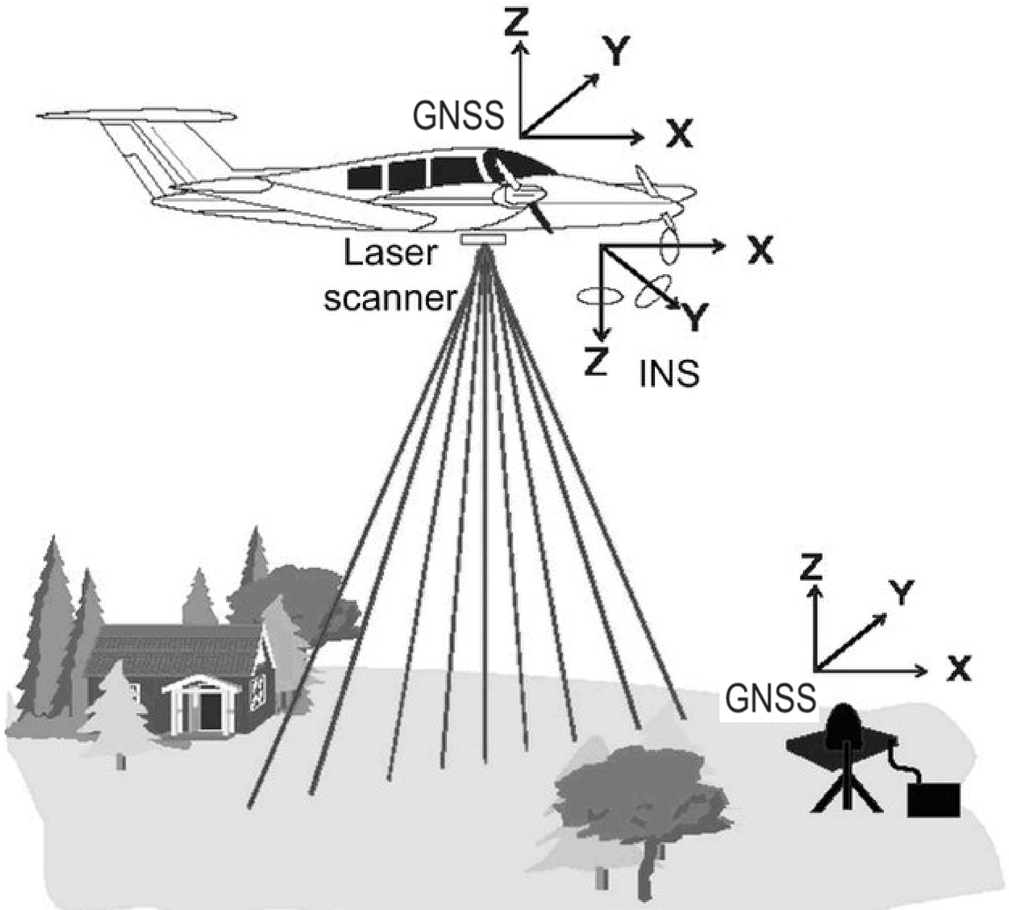
HOW DOES AIRBORNE LASER SCANNING USE GNSS?

GNSS – positioning

IMU – angular velocities, accelerations

Lidar – ranging and scanning

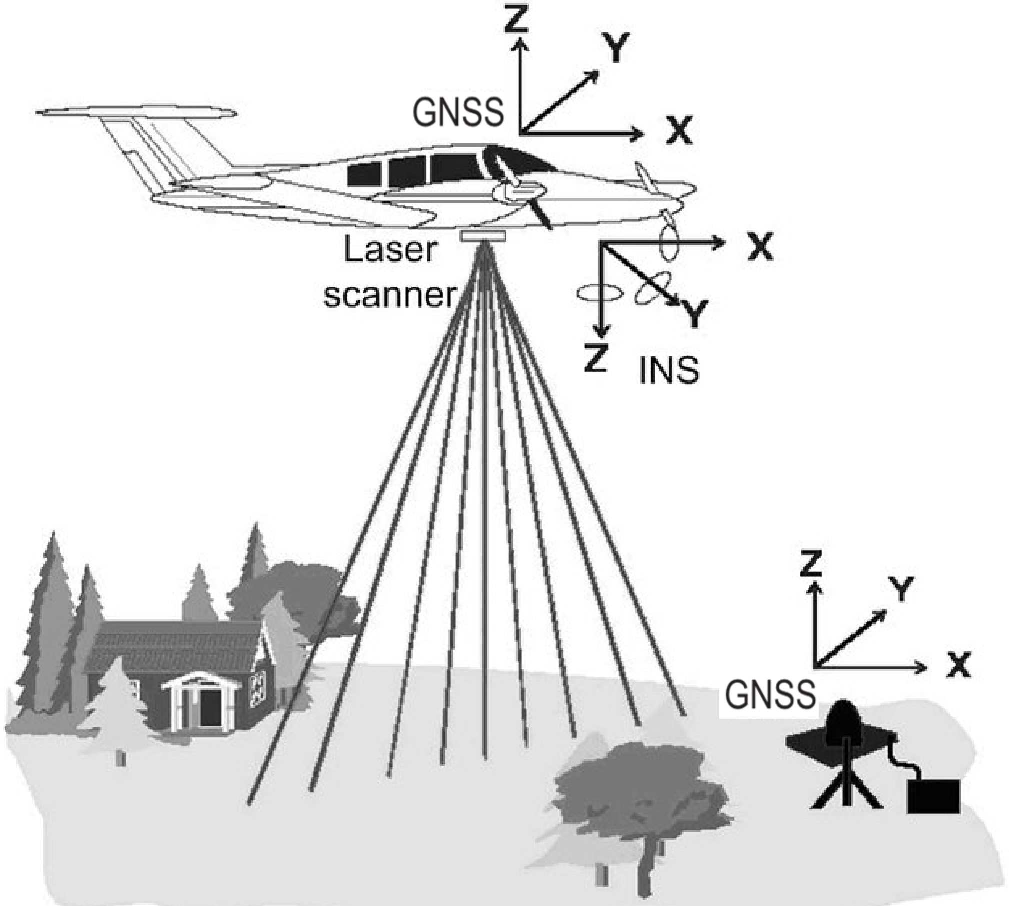


HOW DOES AIRBORNE LASER SCANNING USE GNSS?

GNSS – positioning, 2 Hz

IMU – angular velocities, accelerations, 200 Hz

Lidar – ranging and scanning, 2.4 MHz

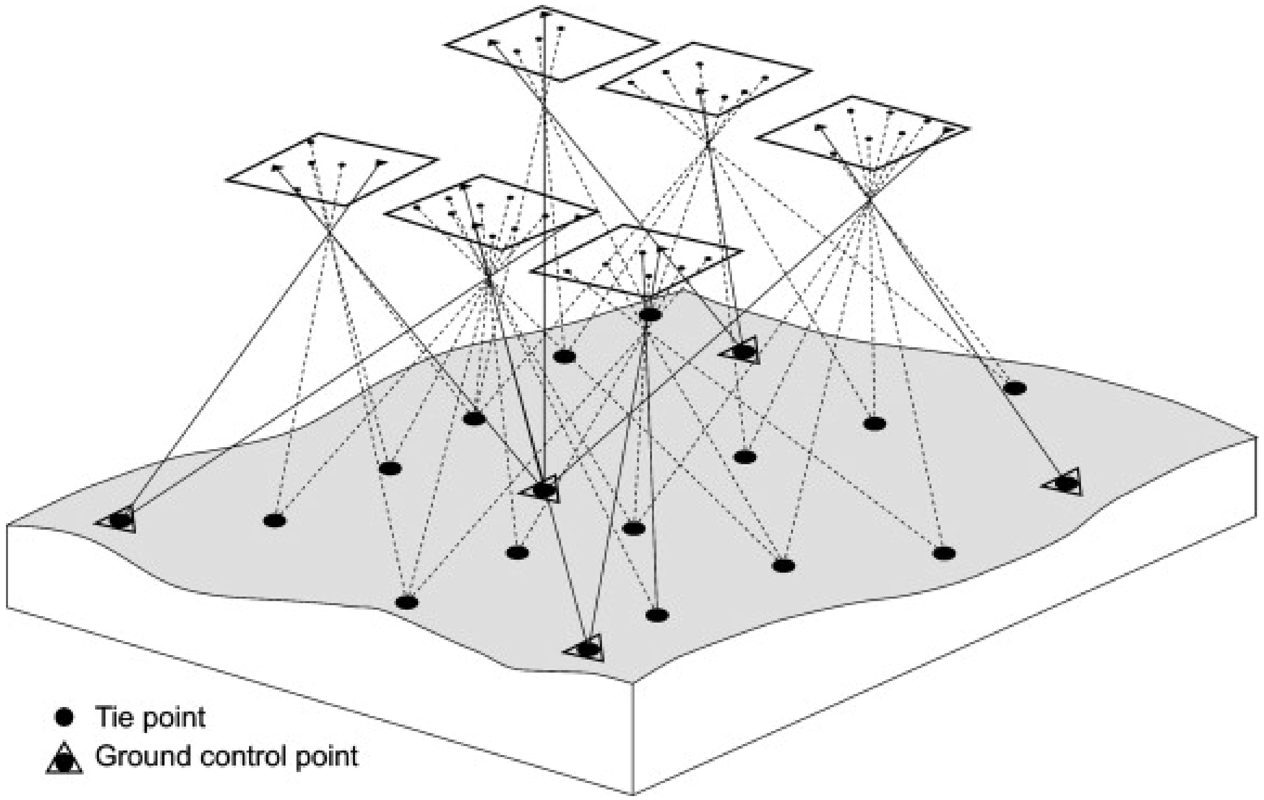


ALTERNATIVE POSITIONING TECHNIQUES

Aerial triangulation

Environmental correlation navigation

- Using old images
- Using old point clouds



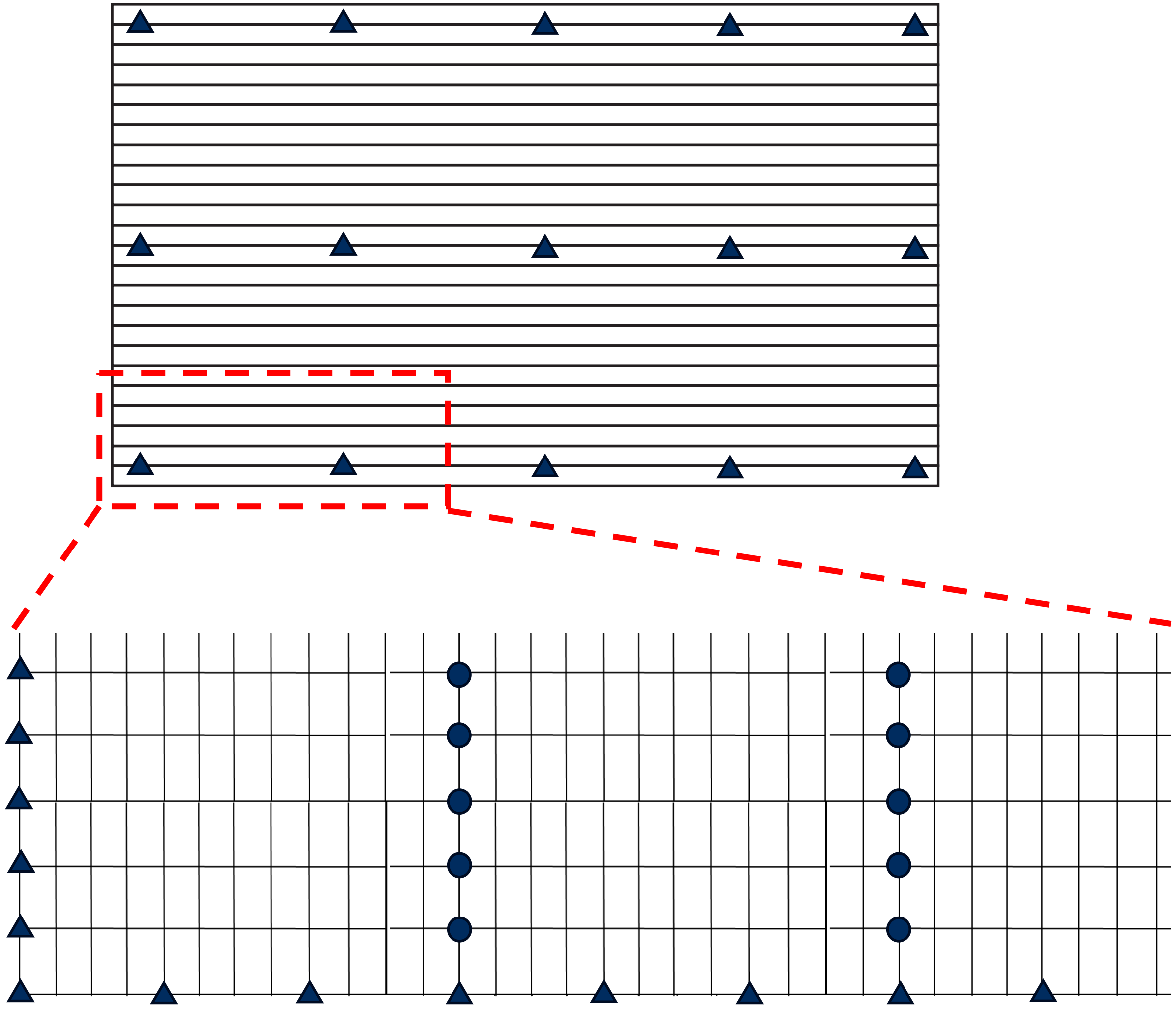
AERIAL TRIANGULATION

Challenges:

Accurate positioning every 0.5 seconds
- High imaging rate
- High resolution images

No GNSS in the aircraft
- More ground control points needed
- Navigation on sight?

No GNSS on the ground
- Map coordinates of natural ground control points
- Traditional land surveying



AERIAL TRIANGULATION

Integrated image and lidar data acquisition

Vexcel UltraCam Dragon
Imaging rate 0.7 seconds

Leica CityMapper-2
Imaging rate 0.9 seconds

Workflow to be adapted

- Allow data acquisition without GNSS
- Aerial triangulation without GNSS
- Different lever arm definition
- Kalman filtering of combined projection centre coordinates and IMU measurements

ENVIRONMENTAL CORRELATION NAVIGATION

Using old orthoimages

- Identify tie points between new images and old orthoimages
- Spatial resections to determine the projection centre locations
- No new ground control points are needed

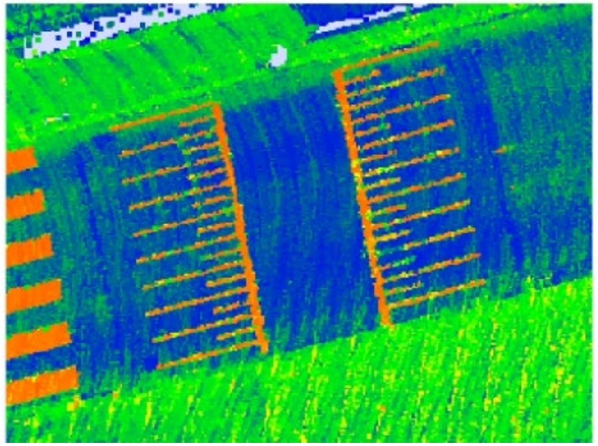
Using an old point cloud

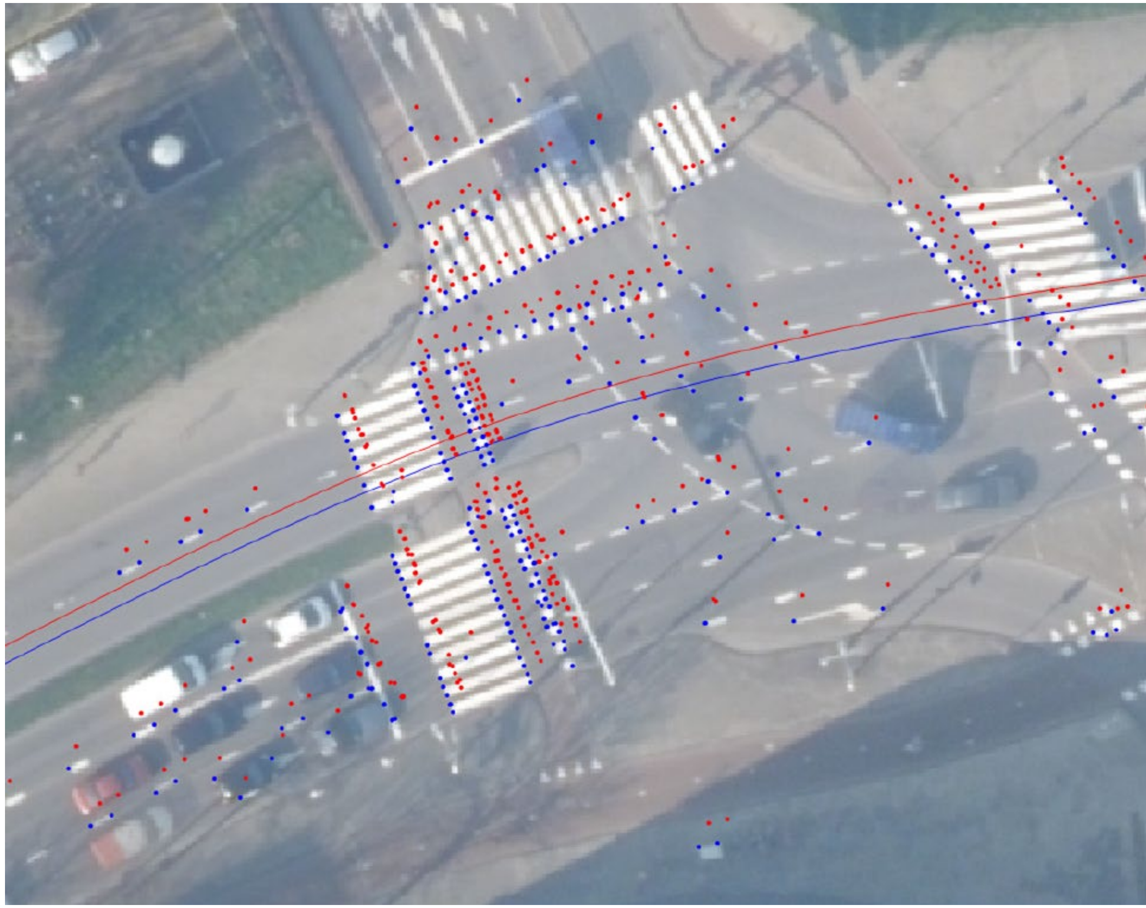
- Use a coarse position estimate and IMU data to generate a point cloud
- Estimate splines of the six pose parameters to minimise discrepancies between the new and old point cloud
- Robustness needed to handle changes

ENVIRONMENTAL CORRELATION NAVIGATION

PhD research Zille Hussnain (2020)

- Poor GNSS positioning in urban canyons affect accuracy of mobile laser scanning point clouds
- Establish tie points to aerial imagery with known poses
- Estimate mobile laser scanner trajectory

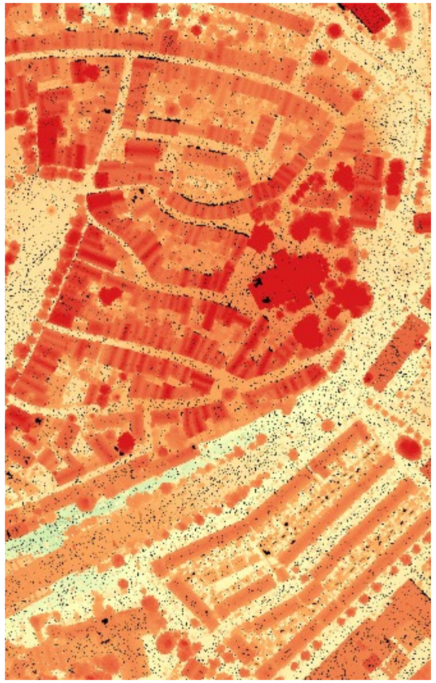
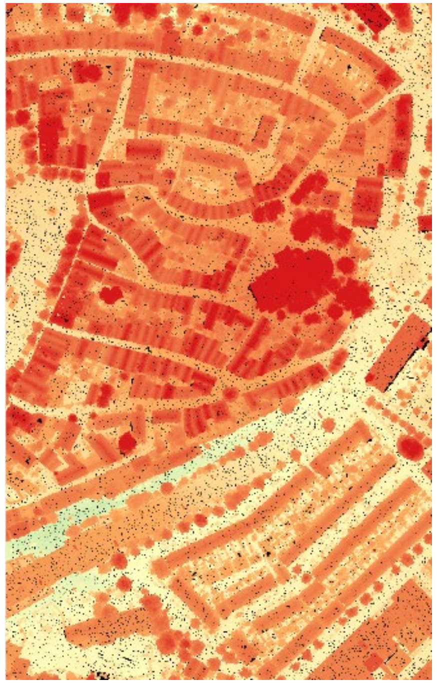
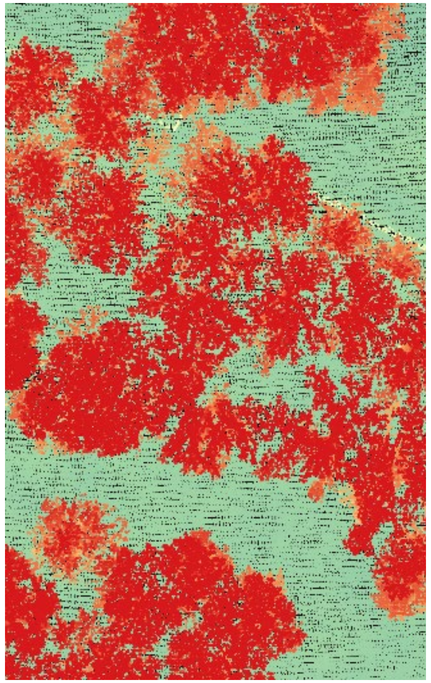
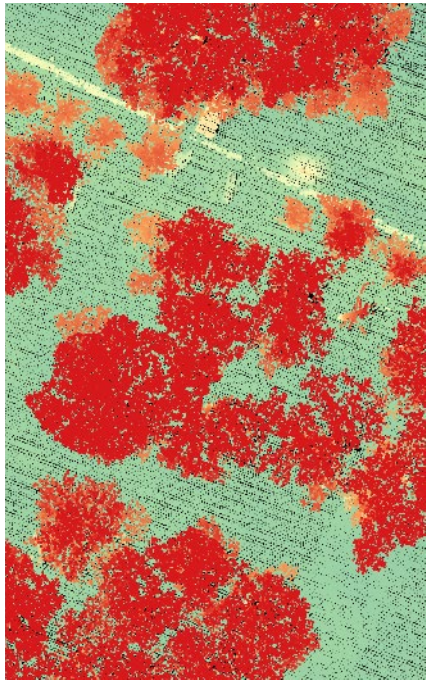




ENVIRONMENTAL CORRELATION NAVIGATION

Challenges

- Identification of changes
- Environmental correlation in highly vegetated areas

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CONCLUSIONS

- Laser scanning without GNSS may be feasible
- A mix of aerial triangulation and environmental correlation will reduce the need for traditional GCPs
- Commercial software must be adapted to the different workflow
- Accuracy of resulting point clouds may be a bit lower

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