COMPETENCE AND TECHNICAL POSSIBILITIES

Bengt Holter, Karsten Husby, Trine Kirkhus, Aksel Transeth (SINTEF Digital)
Bastien Dupuy (SINTEF Industry)
Terje Moen (SINTEF Community)

Research areas

Sensors

- data capture, signal processing and machine learning (anomaly detection in rich data sets)

Communication and positioning technologies

- locating and communicating with objects

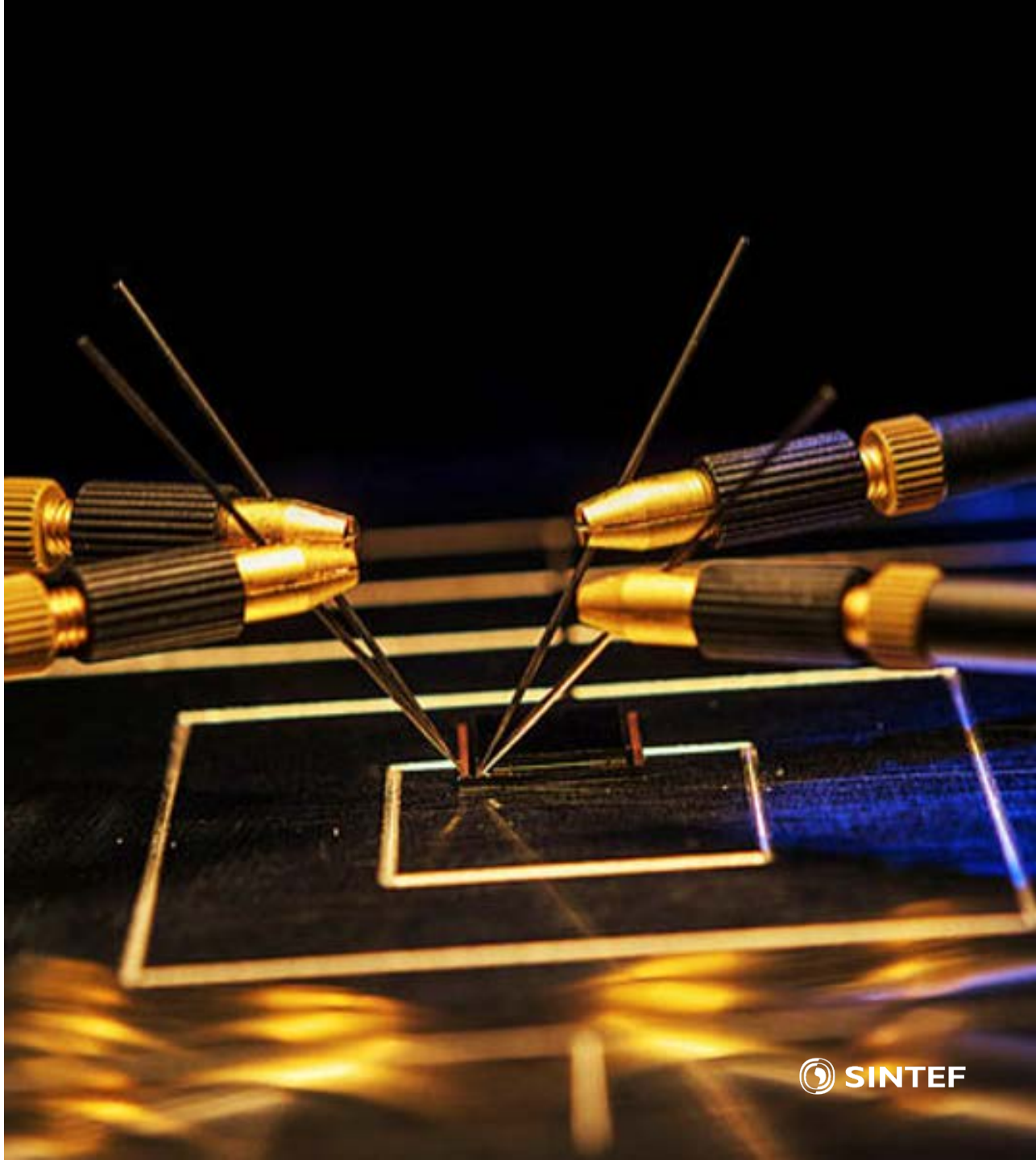
Autonomous aerial drones

- inspection and/or mapping of hazardous areas

Sensors

Sensors is a strategic research area at SINTEF Digital, and we are looking into many different measurement principles in our research

- Electromagnetics
- Acoustics
- Ultrasound
- Optics & Imaging
- Xray
- Vibrational frequency
- Capacitance



Sensors – Electromagnetics

Ground penetrating radar (GPR) as a snow sensor is recently/will be explored in these projects

- **SKNOW project** (2019 – 2022)
  Innovation project in the private sector
  (led by a start-up company)
- **GEODRONES project** (2020 – 2024)
  Strategic internal project initiative at
  SINTEF Industry
- **GEOSFAIR project** (2021 – 2024)
  Innovation project in the public sector
  (led by NPRA)

SKNOW project

- Sensor – Optimized antenna in combination with an ultra wideband ground penetrating radar (GPR) to record snowpack thickness, internal structure of the snowpack (weak layers) and snow properties (hardness/density, water content).
- Sensor platform – Ski
- Goal – Real-time detection of weak snow layers using a ski mounted miniaturized GPR and machine learning

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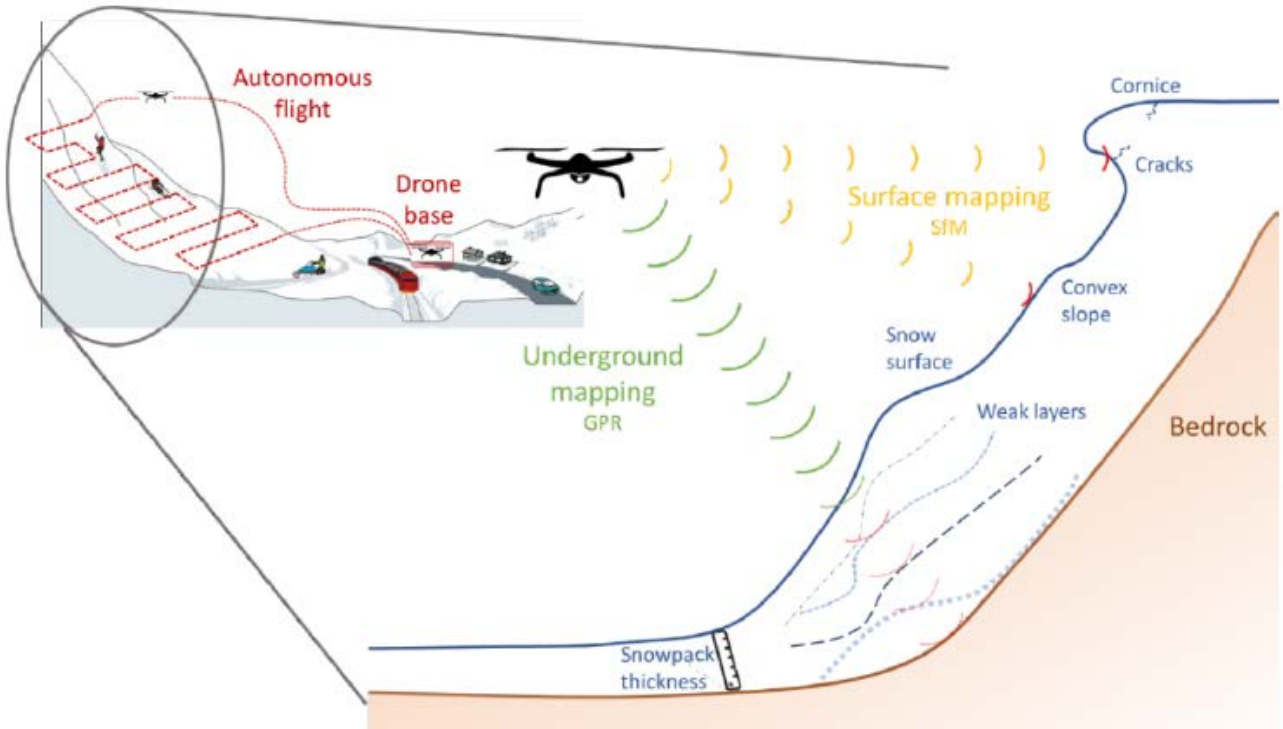
GEODRONES project

GeoDrones: Geophysical mapping and monitoring of natural hazards using multipurpose UAVs

- Sensor – multiple sensors to be tested
- Sensor platform – aerial drone
- Goal – to develop and field test a modular aerial drone platform capable of carrying special geophysical sensors for efficient characterization and monitoring of otherwise inaccessible natural hazard-prone areas and propose innovative ways of handling the recorded dataset.



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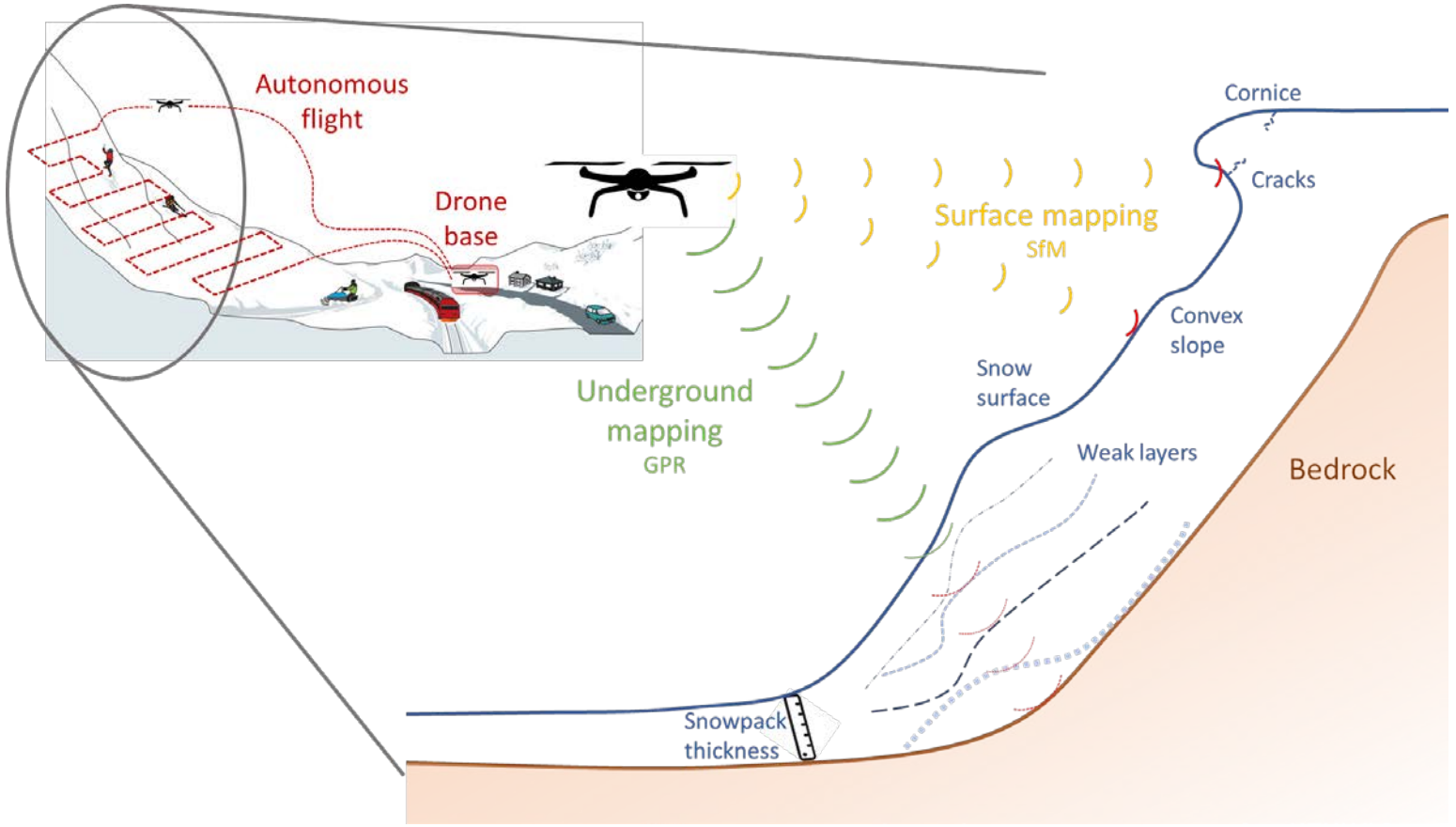
GeoDrones: geophysical mapping and monitoring of natural hazards using multi-purpose UAVs

Landslide, avalanche, flood and rockfall

Motivation: provide repeatable and accurate data to forecast and monitor natural hazards such as snow avalanches, floods, landslides

Strategy: build an autonomous and modular geo-drone platform and develop innovative real-time data processing- and data analysis approaches to help in decision-making. First demonstration on avalanches.



Project facts:

- SINTEF Indutry strategic internal funding
- Budget: 14 MNOK
- Duration: September 2020 – June 2024
- Advisory group: Statens Vegvesen, NVE, Statkraft, Univ. Grenoble (France), SINTEF Digital, SINTEF Community
- Contact: Bastien Dupuy (project leader), bastien.dupuy@sintef.no

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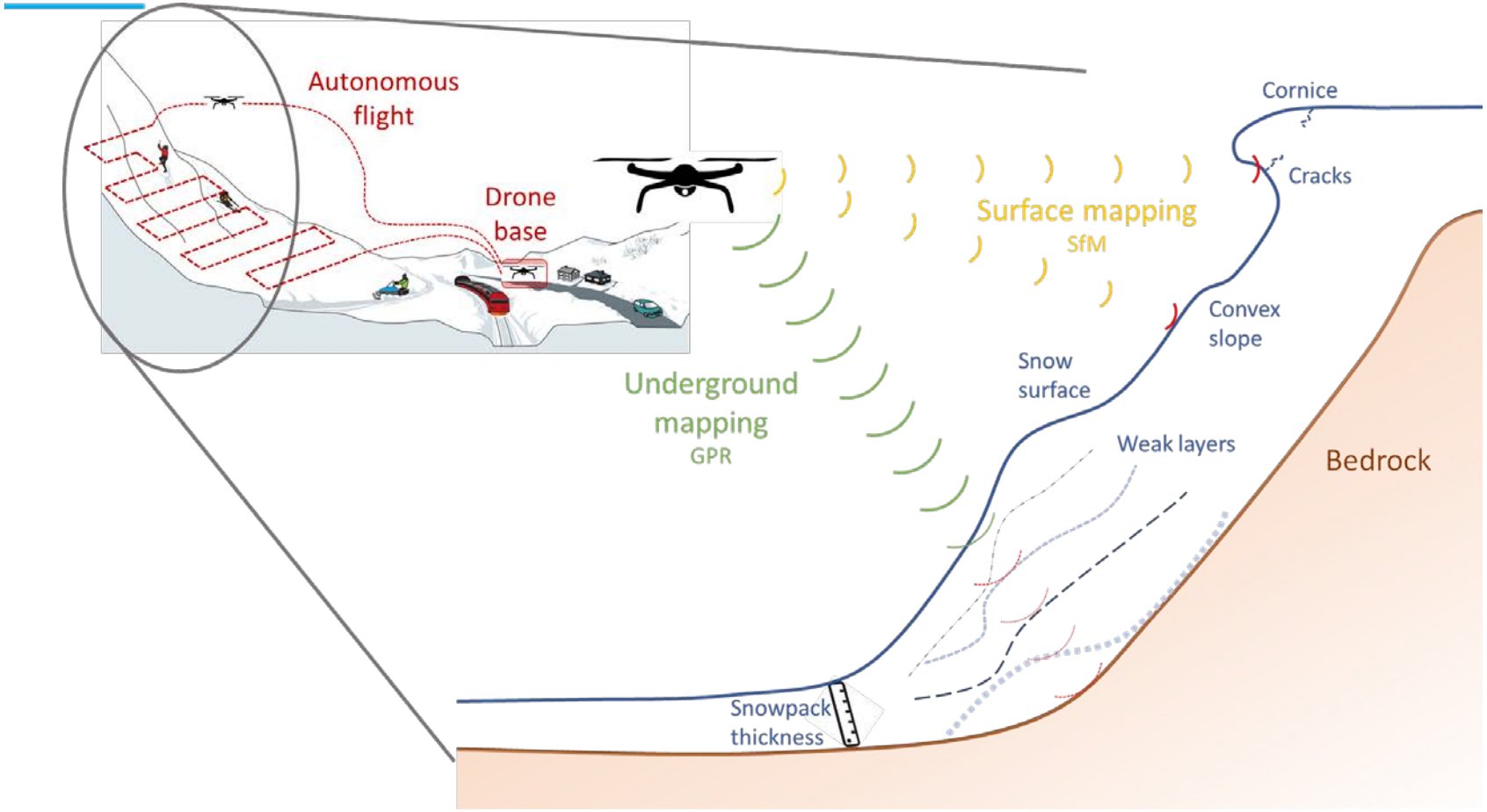
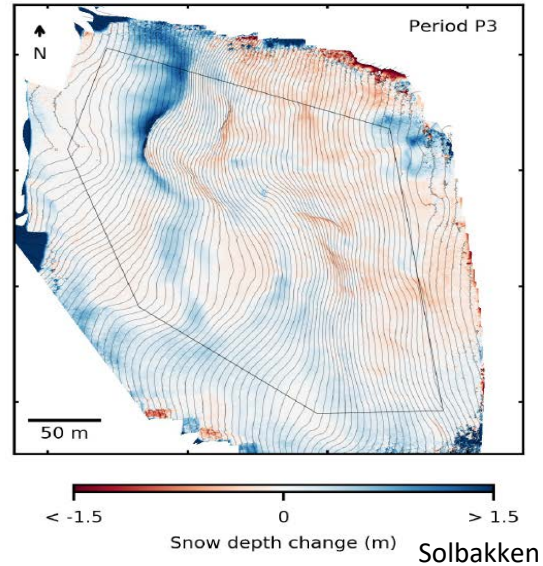
GeoDrone for avalanche forecasting

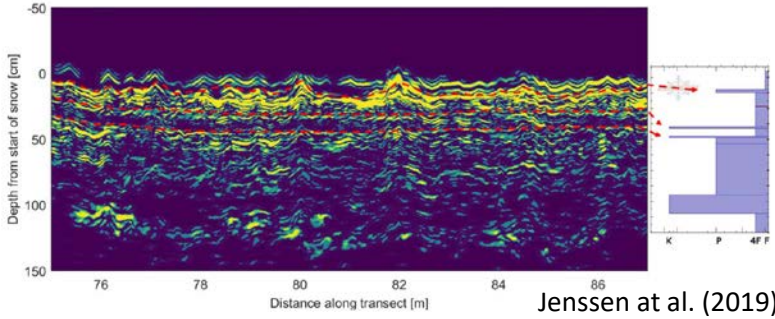


SfM = Surface from Motion
➔ Generate 3D model with high resolution



Solbakken (2019)

GPR = Ground Penetrating Radar
➔ Antenna emitting and recording EM waves that are sensitive to snow layer contrasts

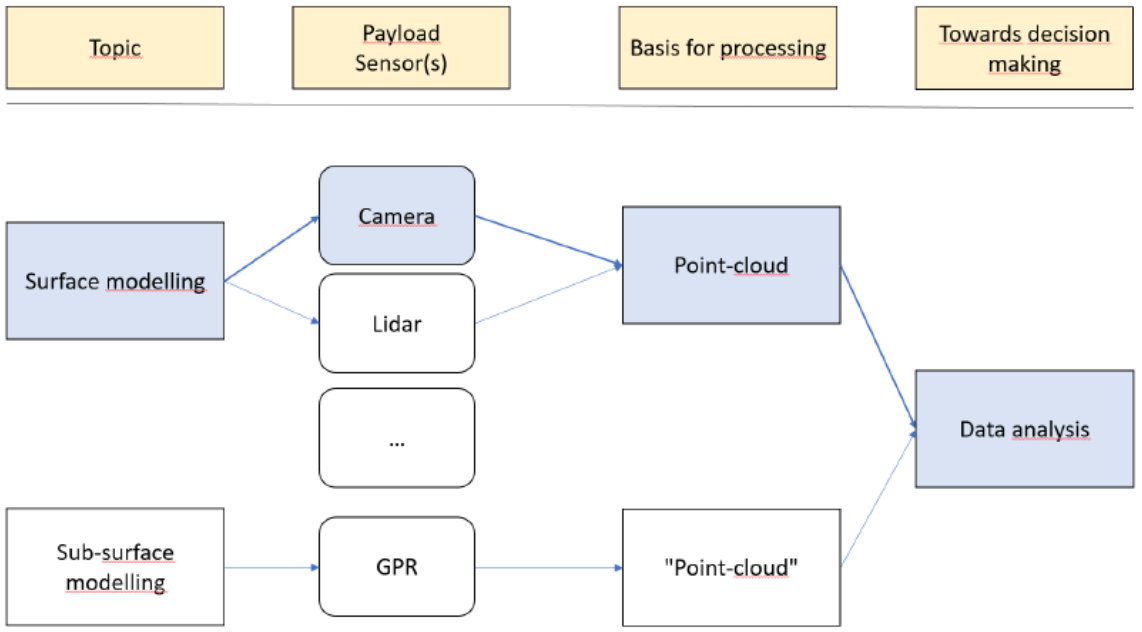


Jenssen at al. (2019)

Hardware/Software and UAV design

- Have built the first custom made SINTEF UAV "Geodrones Prototype One" that meets the current required research needs.
- Established workflows for mission planning and survey creation
  - Advanced mission planning, terrain following, flight autonomy
- Processing workflow
  - Georeferencing, 3D point cloud generation
  - Digital elevation maps

Combination of geophysics with UAV technology to produce tools for specific use cases such as surface and sub-surface monitoring of exposed areas.



Generic procedures:

The pathway to obtaining the desired results should ideally follow the same software/hardware workflow

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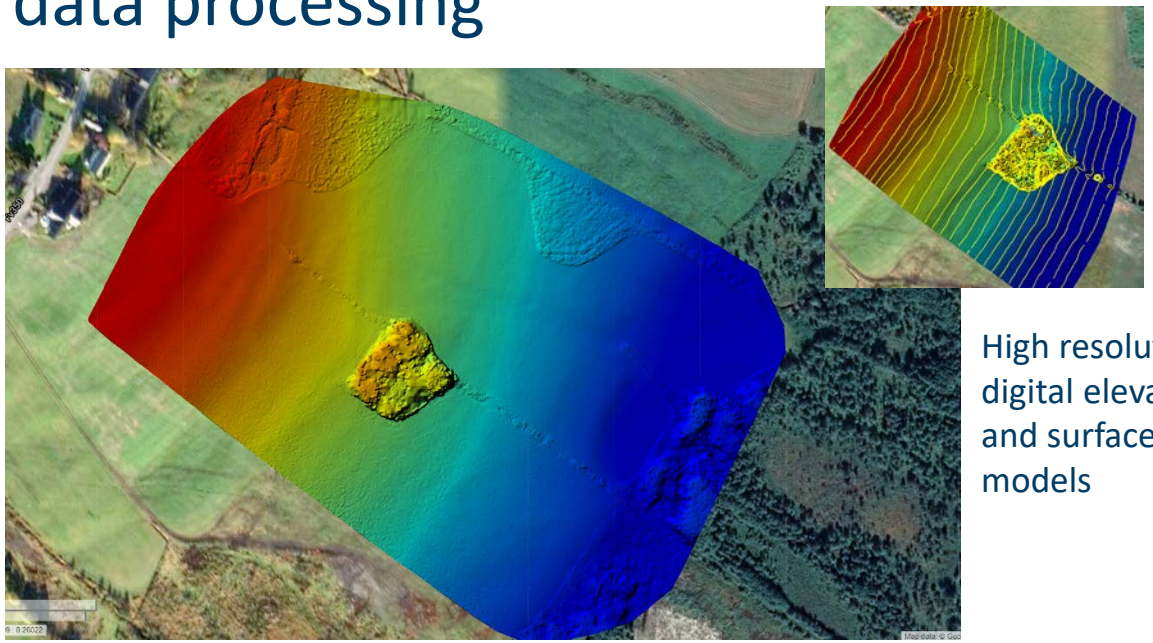
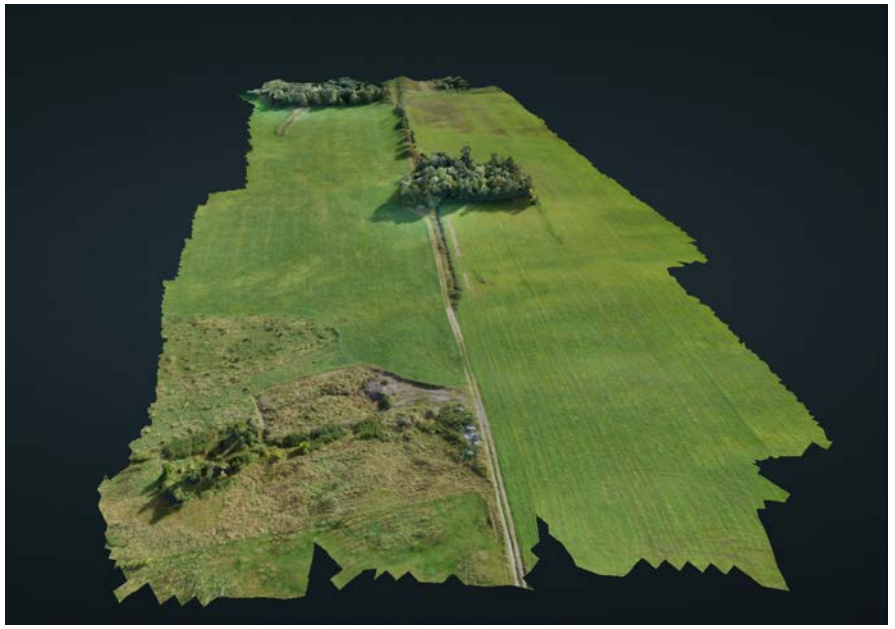
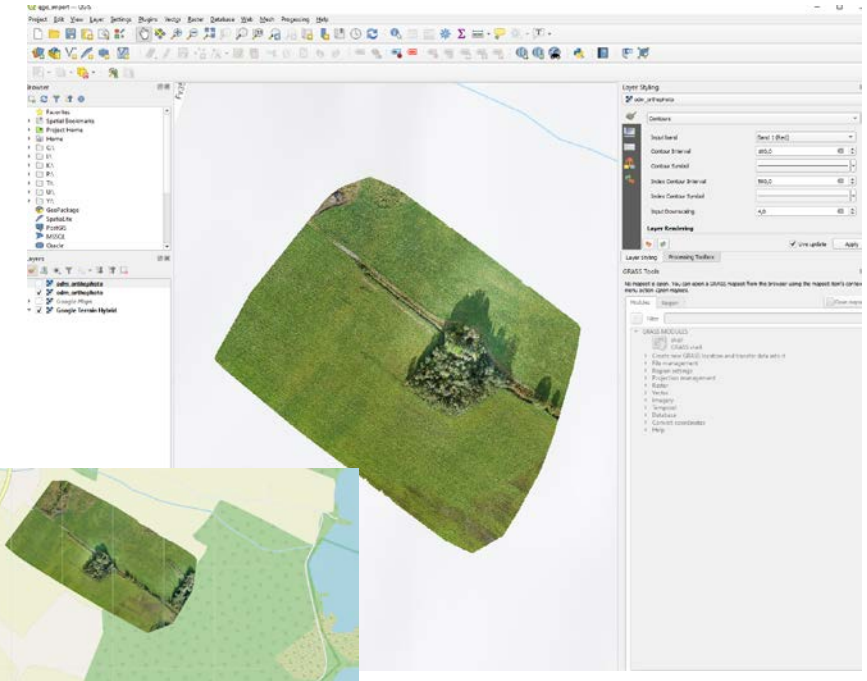
Surface data processing



High resolution digital elevation and surface models

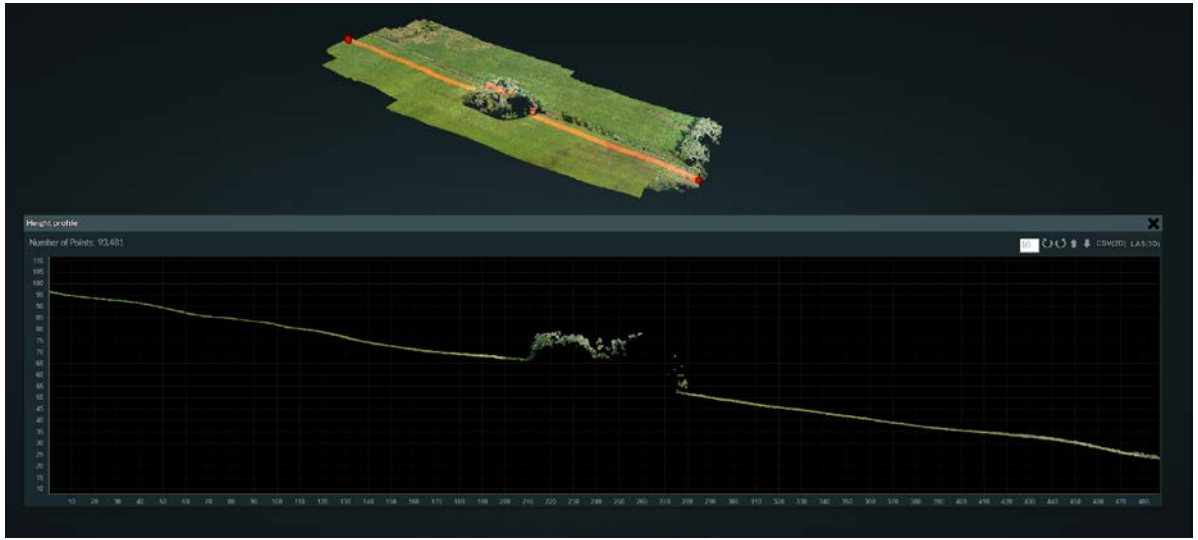
3D interactive view





Georeferenced model in GIS software

Elevation analysis



Texture model and possibility for accurate measurements

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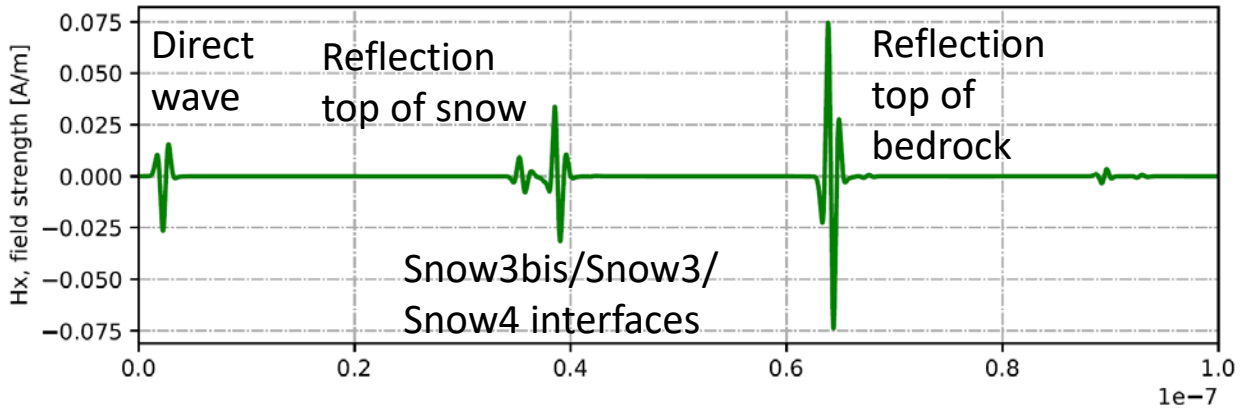
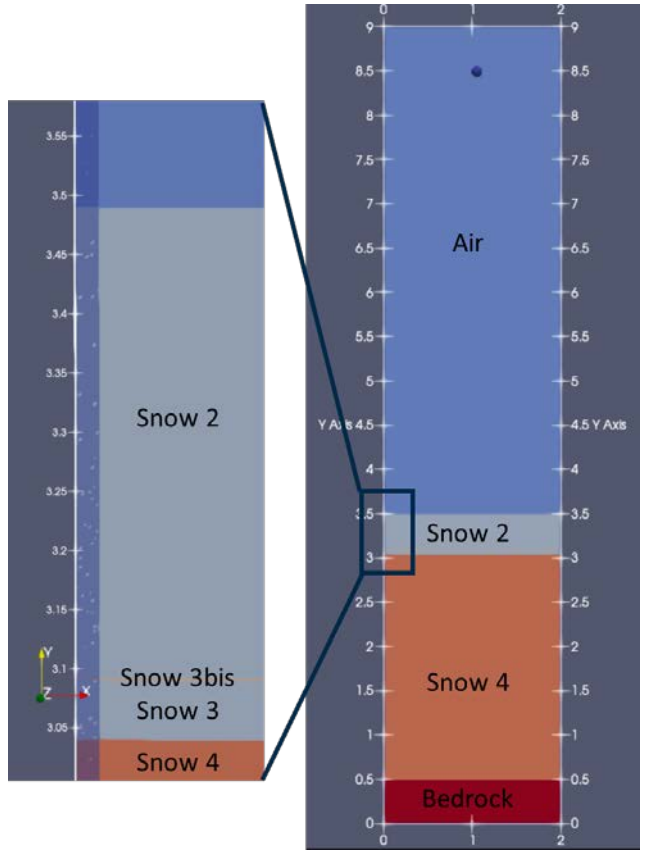
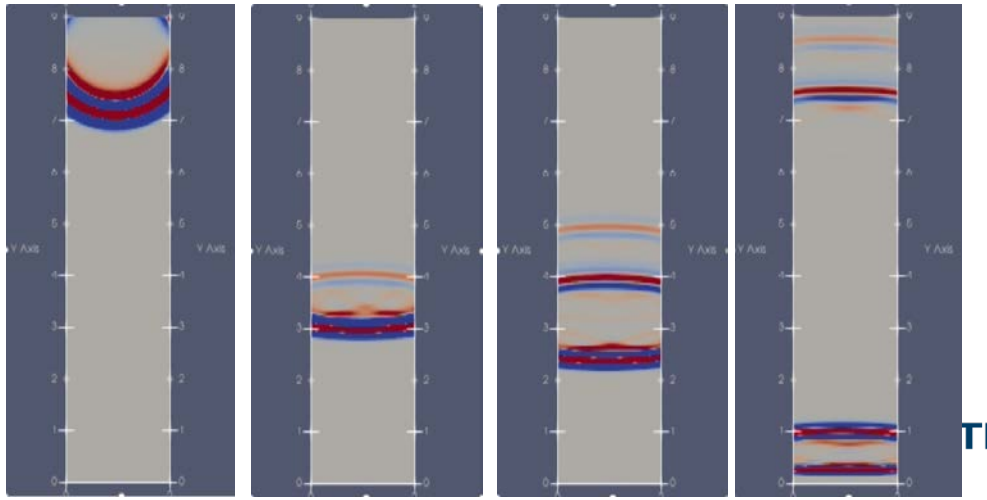
GPR modelling testing

Goal: define antenna frequency range, antenna type and acquisition layout (flight altitude)





- On going work before purchasing GPR antenna and first field tests in 2021.
- In parallel, work on automatization of data processing, interpretation and integration



GEOSFAIR project

GEOSFAIR: Geohazard Survey from Air – remote decision support with focus on avalanche applications

- Sensor – multiple sensors to be tested
- Sensor platform – aerial drone
- Goal – to develop effective methodologies for integrating unmanned aircraft systems (UAS) and UAS-collected data into the present NPRA decision support system for geohazard risk assessment, considering both decision-making requirements and UAS aircraft, sensors, and software specifications. Within the scope of this project, avalanche risk assessment will be the focus.

Statens vegvesen
Norwegian Public Roads Administration

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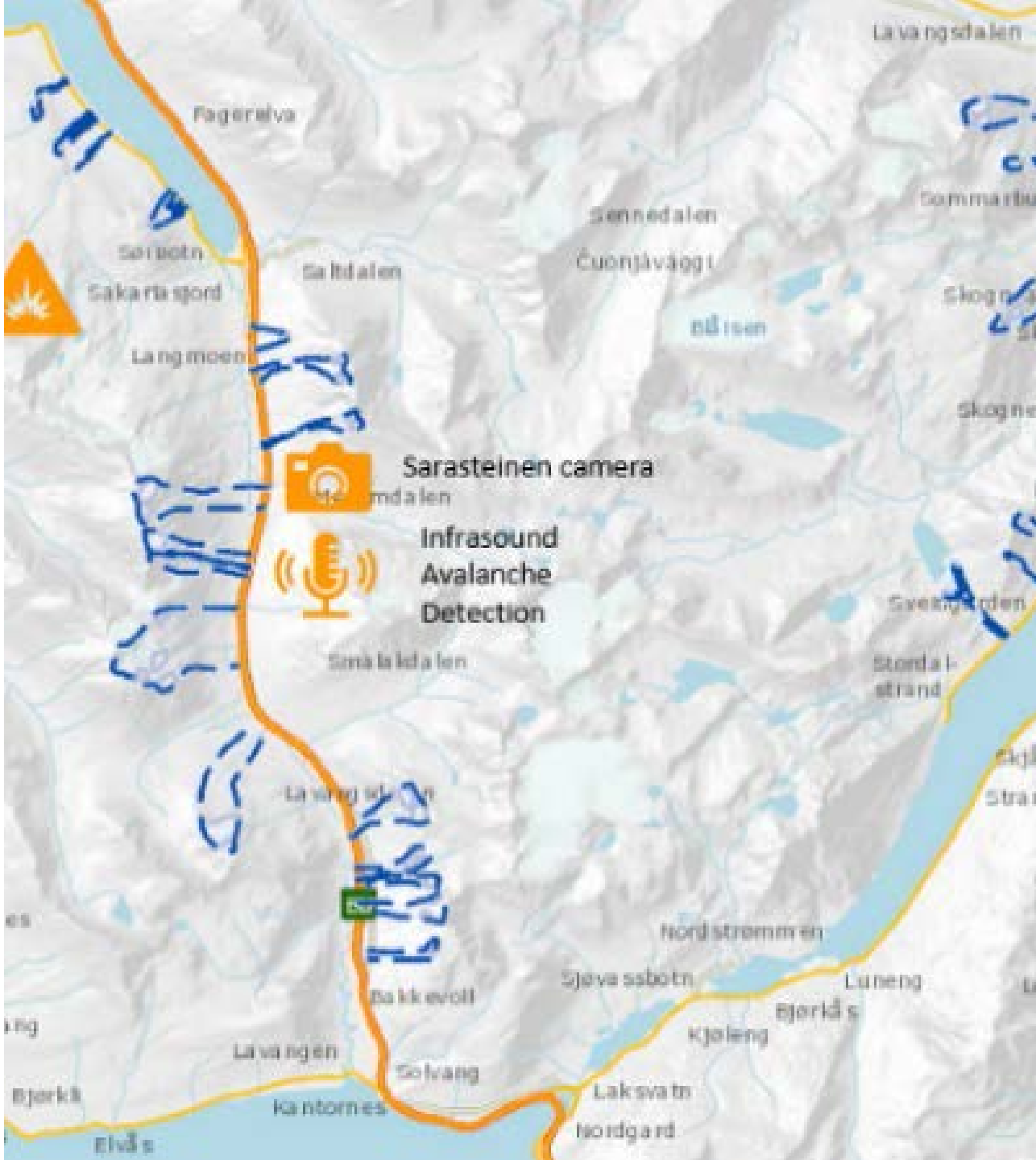
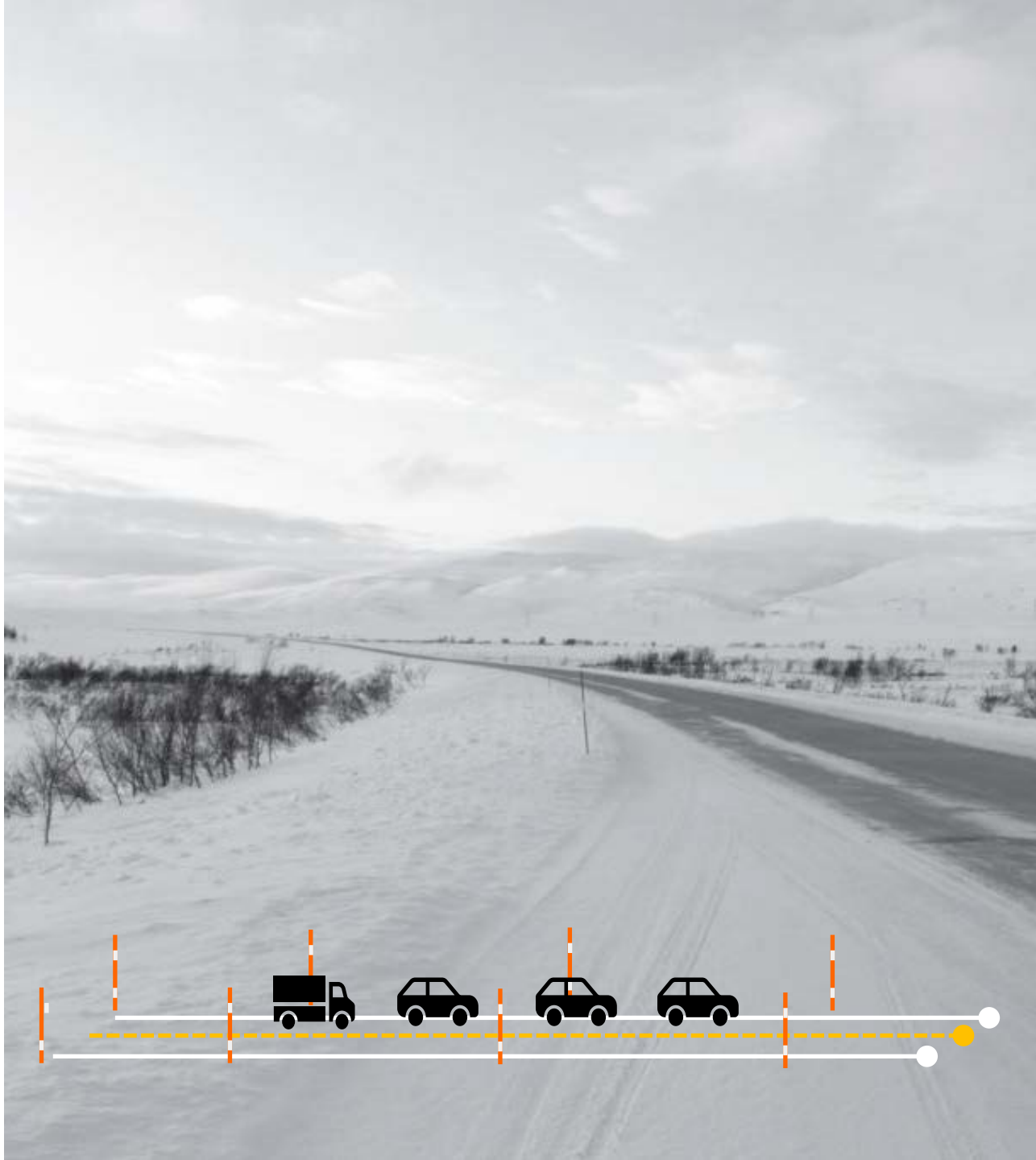


Communication and positioning technologies

- SINTEF Digital has contributed to a start-up company trying to develop a technology where radio devices can be detected when they are in view of a camera (not image recognition).
- A simple test of the current prototype (based on Bluetooth direction finding technology) has shown that the device can be used to locate Bluetooth tags buried in snow.

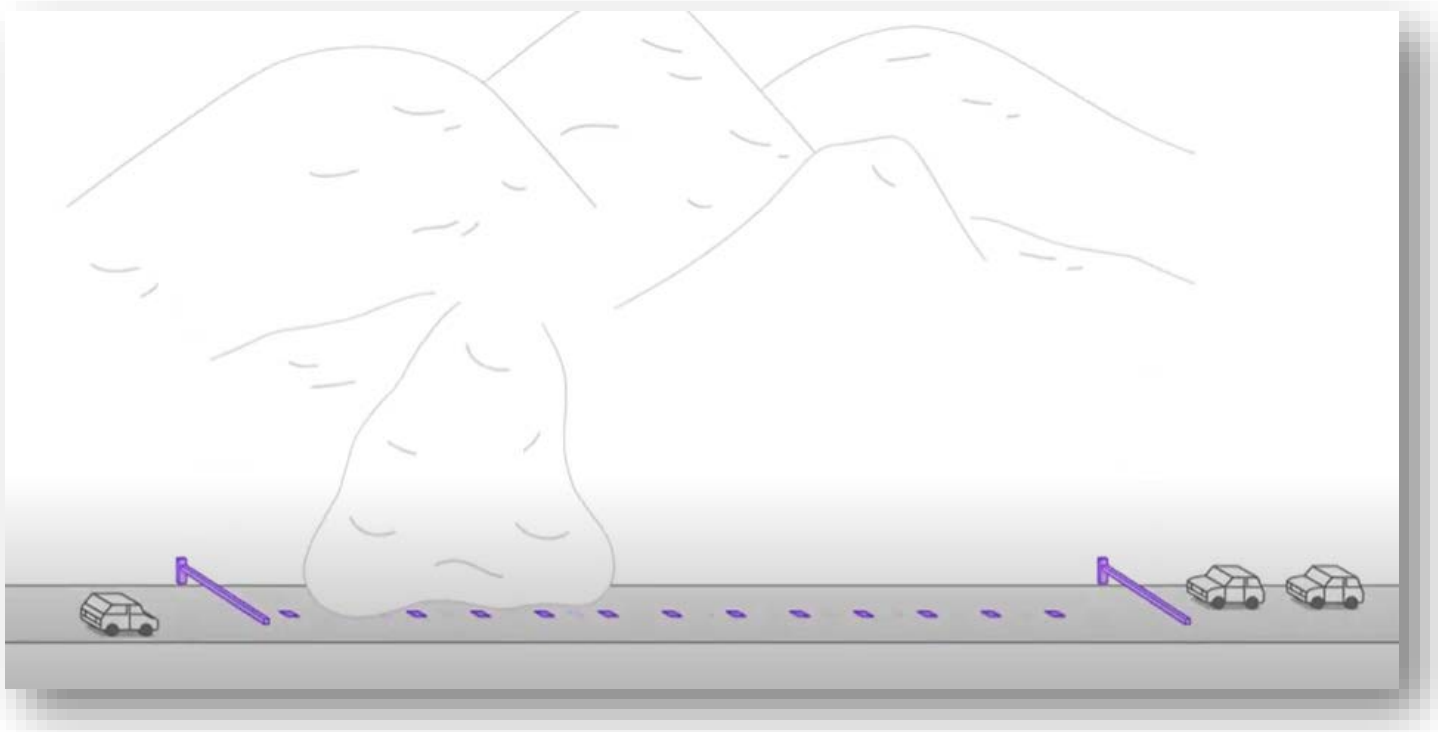
Communication and positioning technologies

- SINTEF Community is the origin of a traffic information system based on the instrumentation of battery-operated sticks along the road (patented concept as of 2020)
- Represents a sensor platform that can enable different applications, i.e. as a source of local weather information



Communication and positioning technologies

- Signals of opportunity could be used to track cars entering and leaving avalanche zones
- Signals of opportunity can also be used to search and locate buried objects.



Autonomous aerial drones

Autonomous drone-based inspection and monitoring of electrical substations

- Path planning
- Sense & avoid
- Localization

Statnett

NORDIC UNMANNED

KVS technologies

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70 år

1950-2020

Teknologi for et bedre samfunn