

LANDSLIDE CHARACTERIZATION AND MONITORING USING FIBER-OPTICS AND DENSE NODAL ARRAYS

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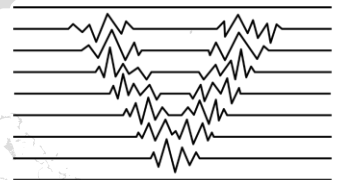
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SPIN

MONITORING A
RESTLESS EARTH

MOTIVATION

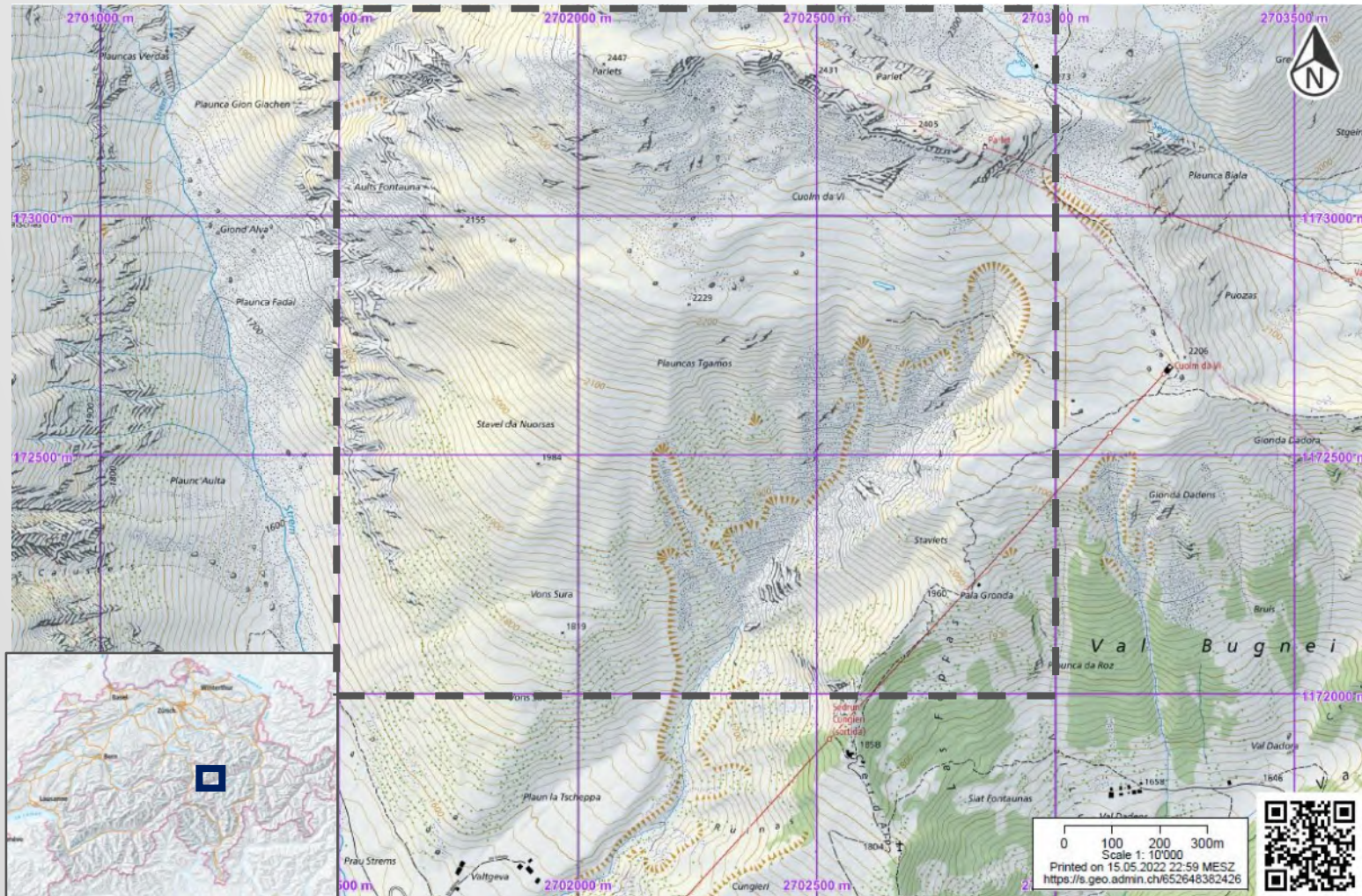
Develop and apply novel seismic techniques to characterize and monitor unstable slopes

→ Mitigate risks for human life, infrastructure and ecosystems

Key questions

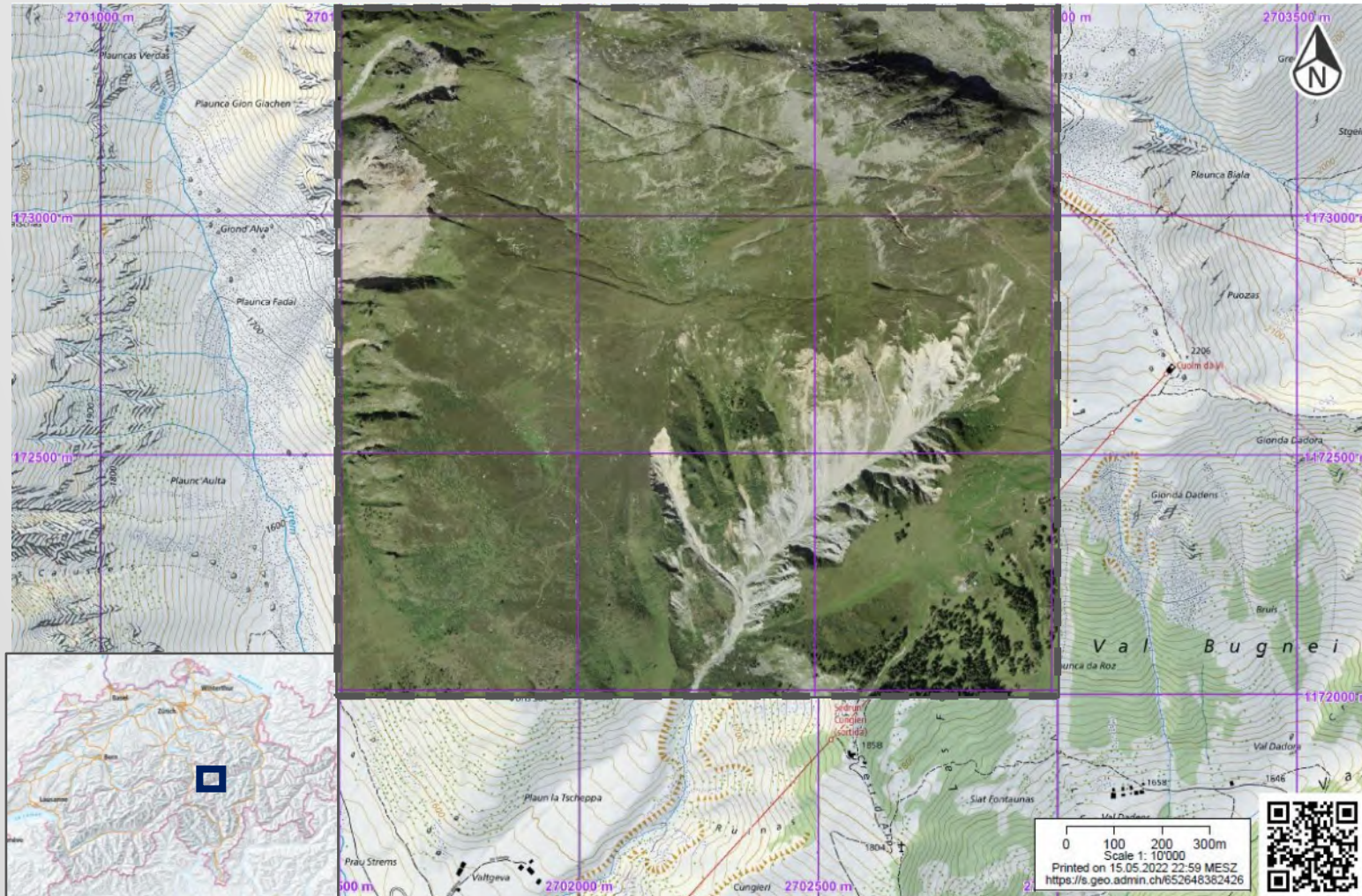
1. *How to maximize the value of dense nodal arrays (~1000 sensors) to characterize the structure of large landslide bodies?*
2. *How to employ fiber-optic techniques (DAS & DSS) to monitor landslide characteristics and dynamics over time?*

TEST SITE: CUOLM DA VI



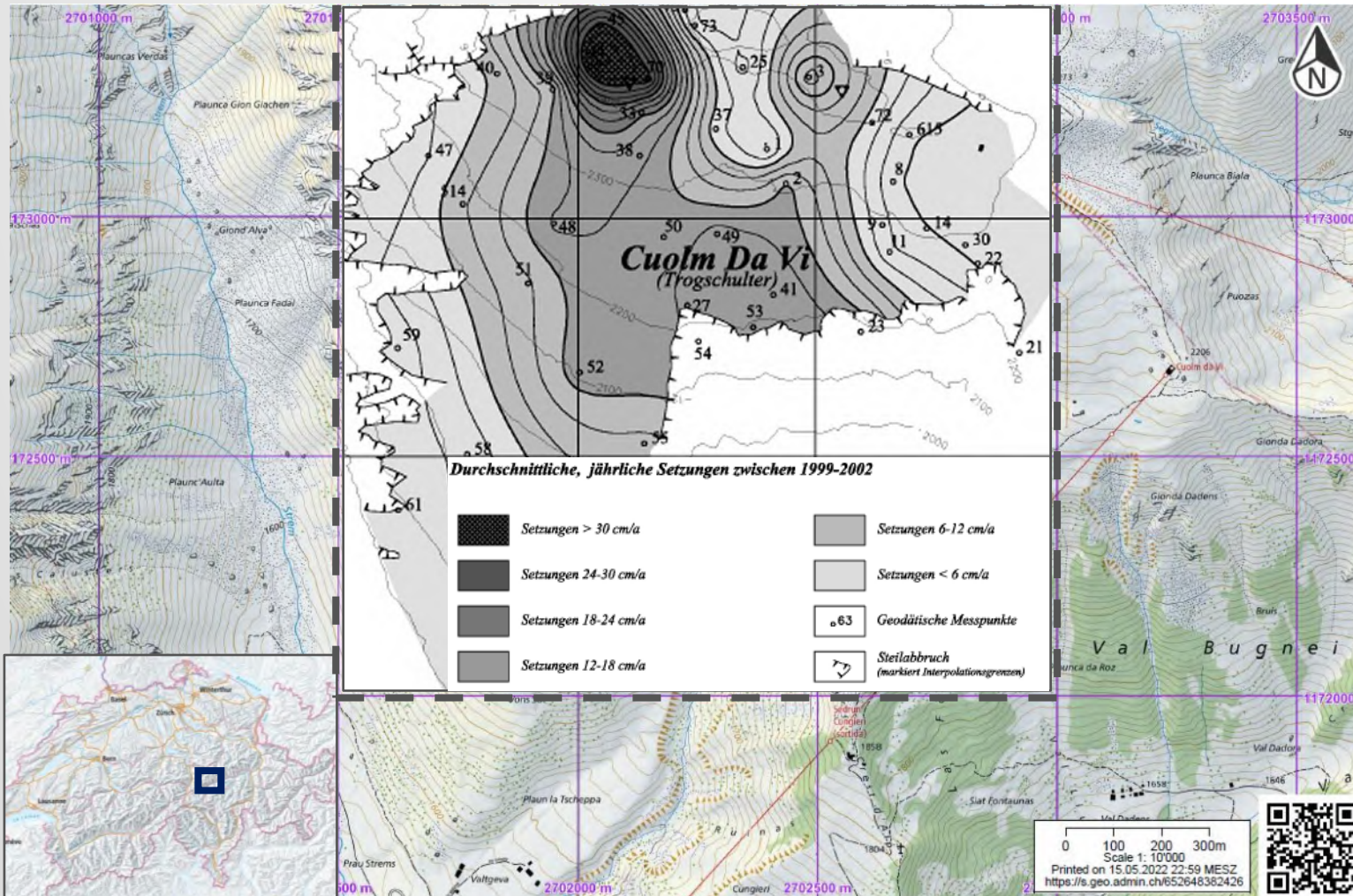
- Large-scale landslide
 - ~1.5 x 1.5km

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- **Large-scale landslide**
 - ~1.5 x 1.5km
- **Surface deformation**
 - 10 – 30cm / year
- **Heavily instrumented at surface**

GENERAL PROJECT SETUP

June/July 2022

- Deployment nodal array
- Installing 1st stretches of fiber-optics



Sept/Oct 2022

- 'Learn' from 1st campaign
- Extending fiber-optic coverage



Spring 2023

- Main fiber-optic acquisition phase
- Snowmelt → Highest 'activity'

SENSORS & TARGETS

Large nodal array	Distributed Acoustic Sensing (DAS)	Distributed Strain Sensing (DSS)
<ul style="list-style-type: none"> ➤ 1000 autonomous 1C-nodes ➤ Duration: 1 month <p>→ Construction tomographic model</p> <ul style="list-style-type: none"> • Active shots: P-wave • Ambient noise surface wave tomography <p>→ Localize micro-seismicity / tremor</p> <ul style="list-style-type: none"> • Beamforming • Matched Field Processing (MFP) 	<ul style="list-style-type: none"> ➤ 6km DAS cable ➤ Duration: years <p>→ Objectives similar to nodal array, however:</p> <ul style="list-style-type: none"> • Vertical (node) vs. horizontal (DAS) sensitivity <p>→ More focus on changes over time</p> <ul style="list-style-type: none"> • Development micro-seismicity / tremor • dv/v - monitoring 	<ul style="list-style-type: none"> ➤ 1km DSS cable ➤ Interrogator at regular intervals <p>→ Absolute strain measurements over time</p> <ul style="list-style-type: none"> • Correlation with seismic observables

HAPPY TO FURTHER DISCUSS AT POSTER:

Nodal array

- Optimal layout for beamforming / MFP
- Exploiting gradient information

Fiber-optics

- Optimizing DAS (layouts) for ambient noise based methods
- Adding specific fiber shapes

→ How to combine DAS and nodes in a smart way?