



Motivation

Microseismic monitoring using large-scale Distributed Acoustic Sensing (DAS)

→ Analyse subsurface landslide dynamics in space and time

1. Establish a seismic event catalogue from long-term DAS acquisition
2. Localize natural signals using DAS-adapted Matched Field Processing
3. Investigate spatial and temporal patterns of seismicity, in relation to
 - Known geological structures
 - Environmental forcing (precipitation, snowmelt)

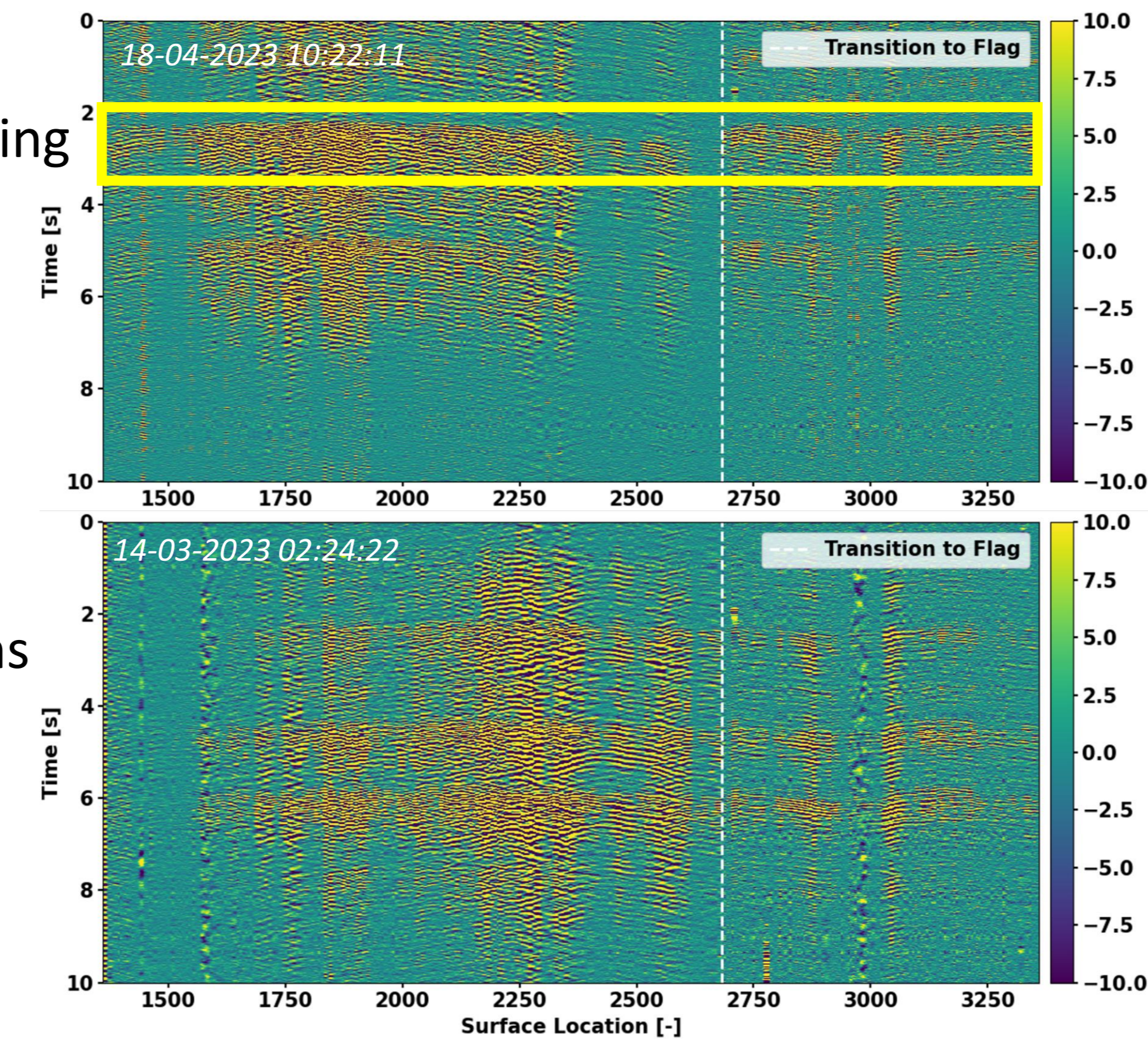
Acquisition & Event Catalogue

DAS Data Acquisition

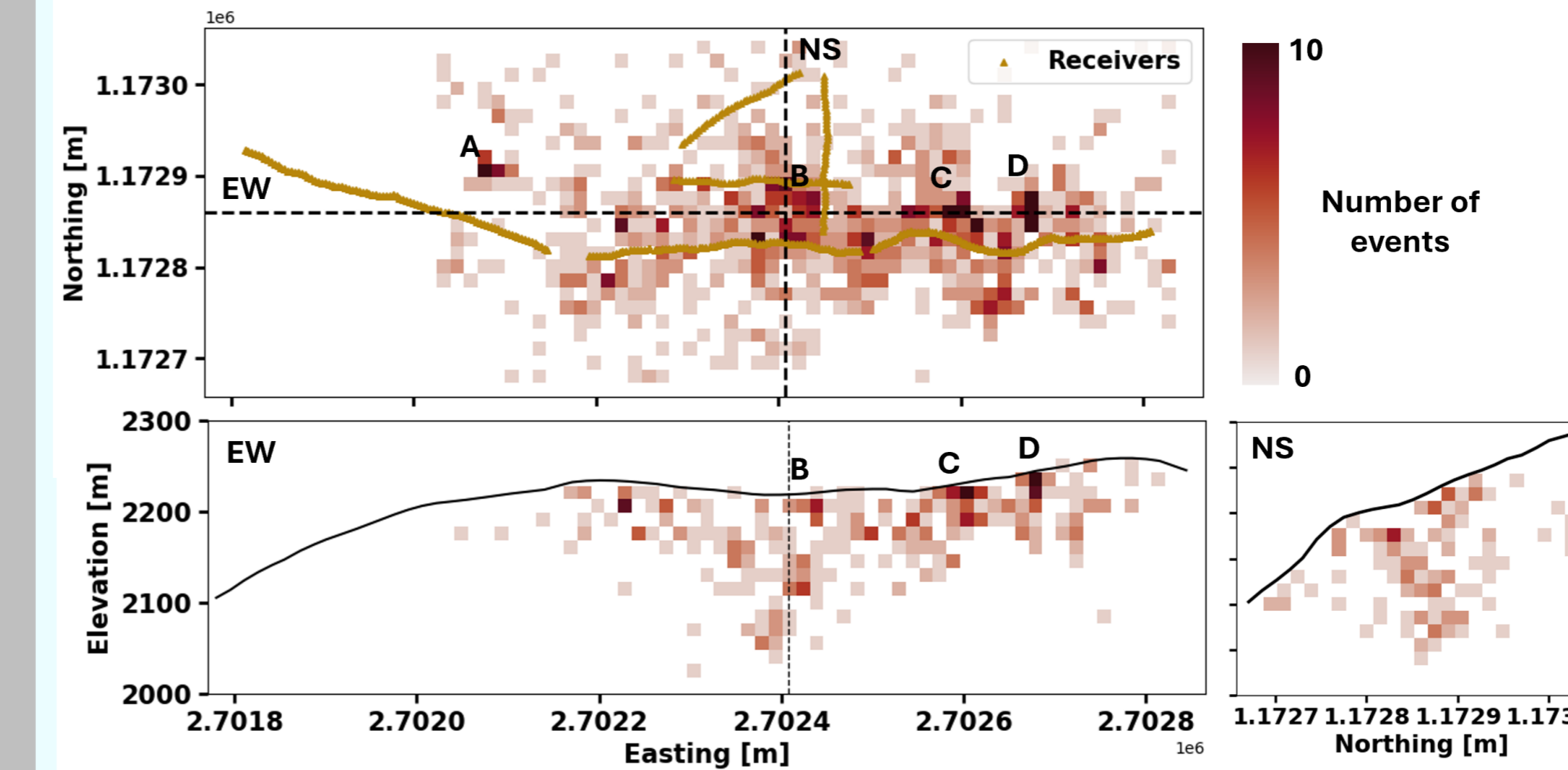
- Febr. - July 2023: continuous recording
- Sampling rate: 250Hz
- 1m channel spacing → ~6500 chan.

Event Catalogue

- >7,000 detections over 5 months
- Hierarchical clustering on waveforms
- 3 clusters of local & natural origin selected
- Yielded 1,277 distinct events for spatio-temporal analysis



Spatio-Temporal Analysis

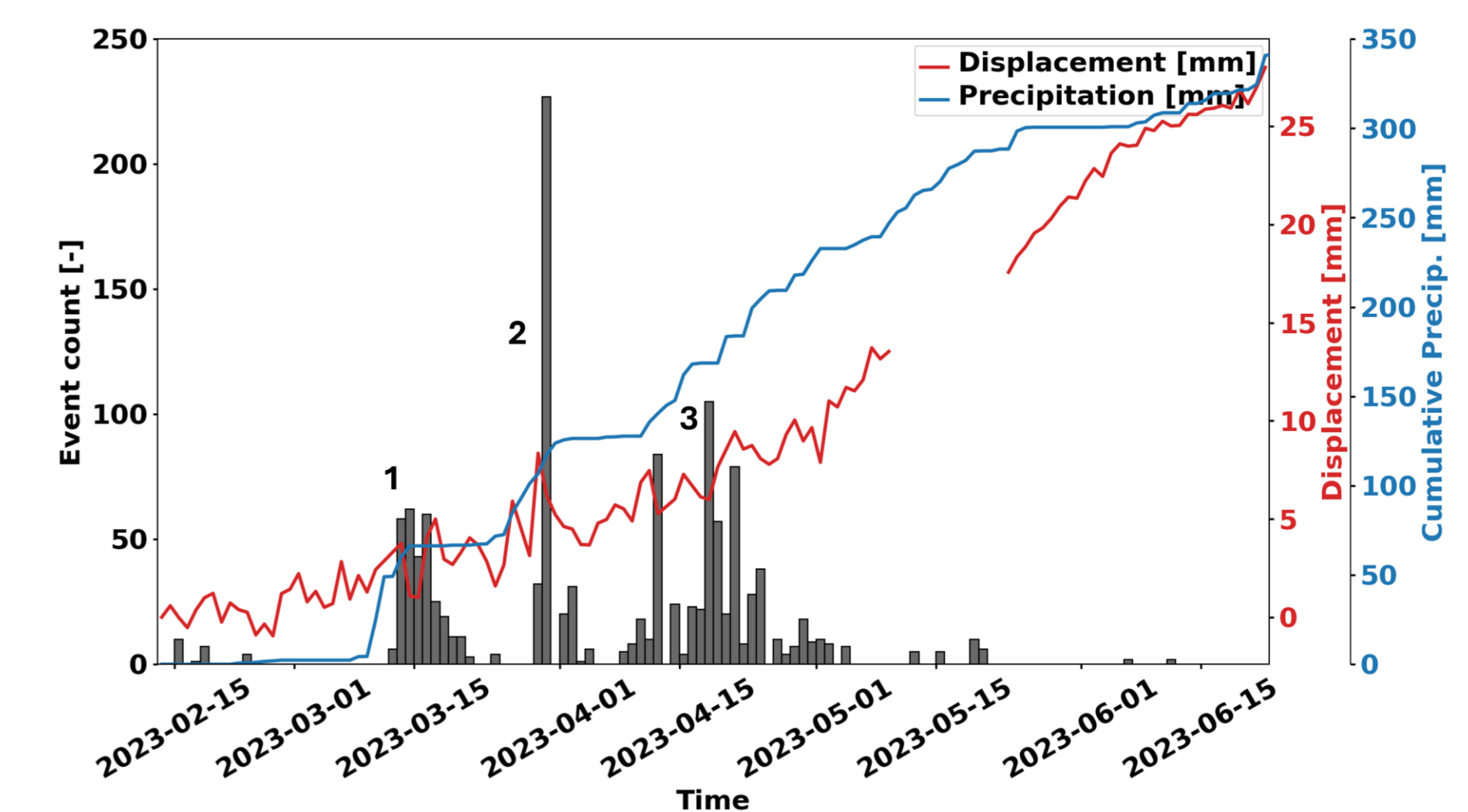


Space

- Four high-density clusters (A-D) identified
- Aligning with known fracture systems
- Events at greater depth (up to 200m) toward instability centre
- Consistent with geological and Vp-model

Time

- Three main seismicity phases
- Phase 1 & 2:
 - Following major precipitation & snowmelt
 - Coincide with displacement variability
- Near-complete absence of seismicity in May-June despite strong displacement



Space-time

- Spatial migration patterns at different time-scales (hours to weeks)
- Left: migration at daily scale
- activity shifts from east to west within 30 hours after onset of phase 1
- Spatially heterogeneous dynamics

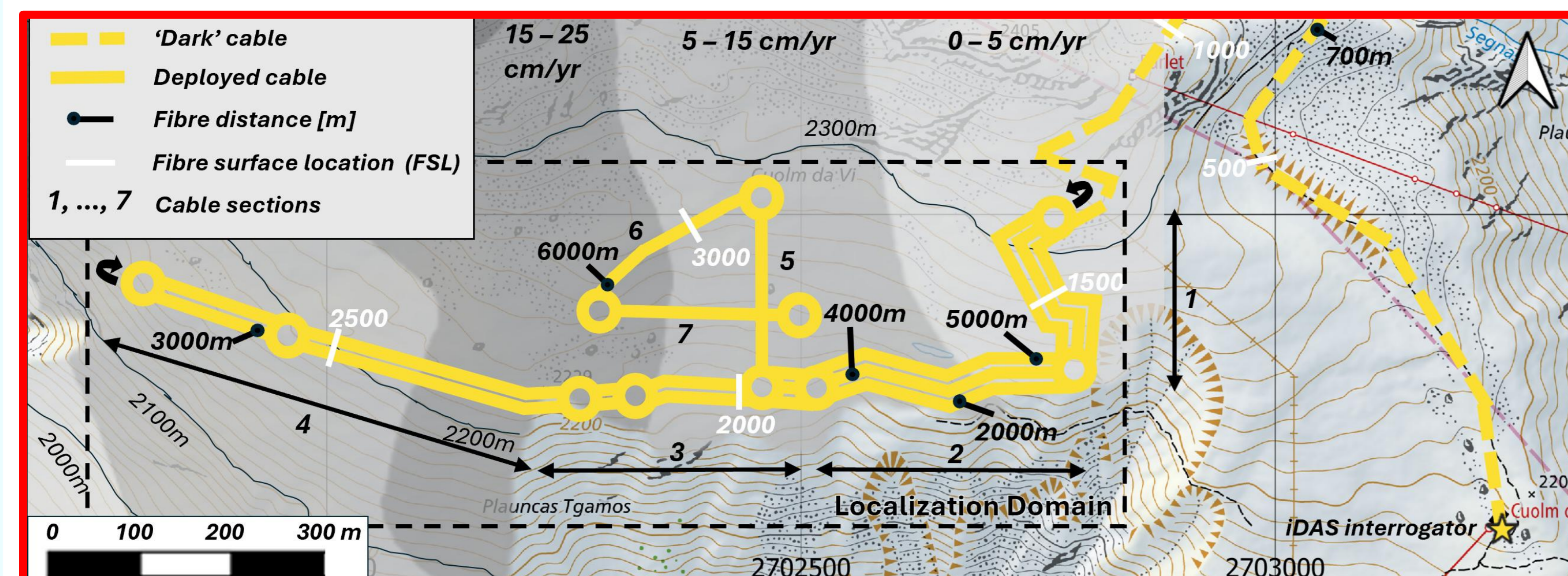
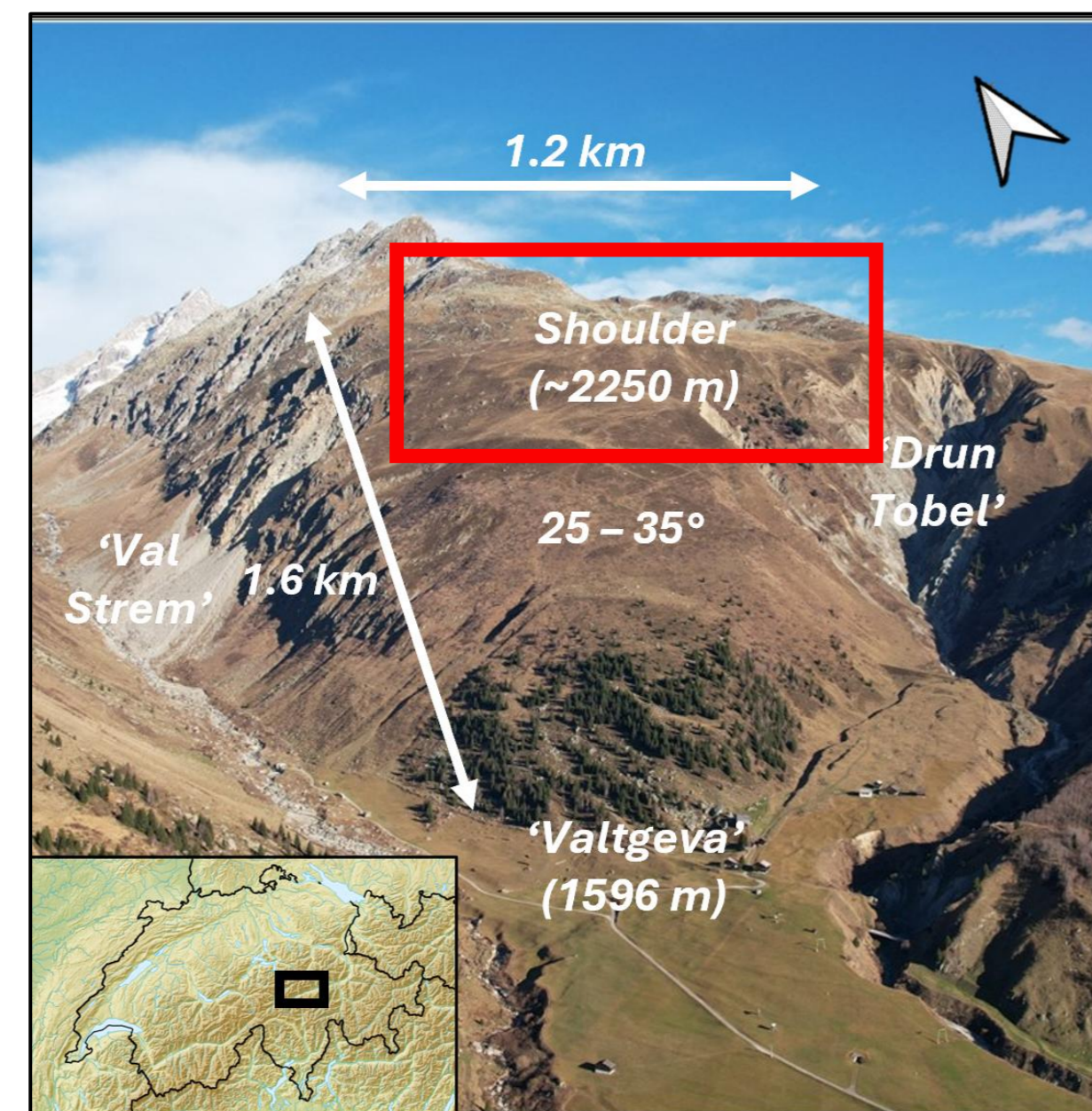
'Cuolm da Vi' Fibre-Optic Network

Study site: 'Cuolm da Vi'

- Location: Sedrun, Switzerland
- Area: ~1.5 km², Volume: ~150 x 10⁶ m³
- Displacement: 10 – 25 cm/yr

Deployed Fibre-Optic Network

- 6500 m of trenched fibre-optic cable
- Covering the central (fastest-moving) area
- Suited for long-term parallel DAS & DSS



DAS-adapted Matched Field Processing

Pre-processing

- Excluding cable section 1
- Filtering: 15-30Hz

Strain rate → velocity

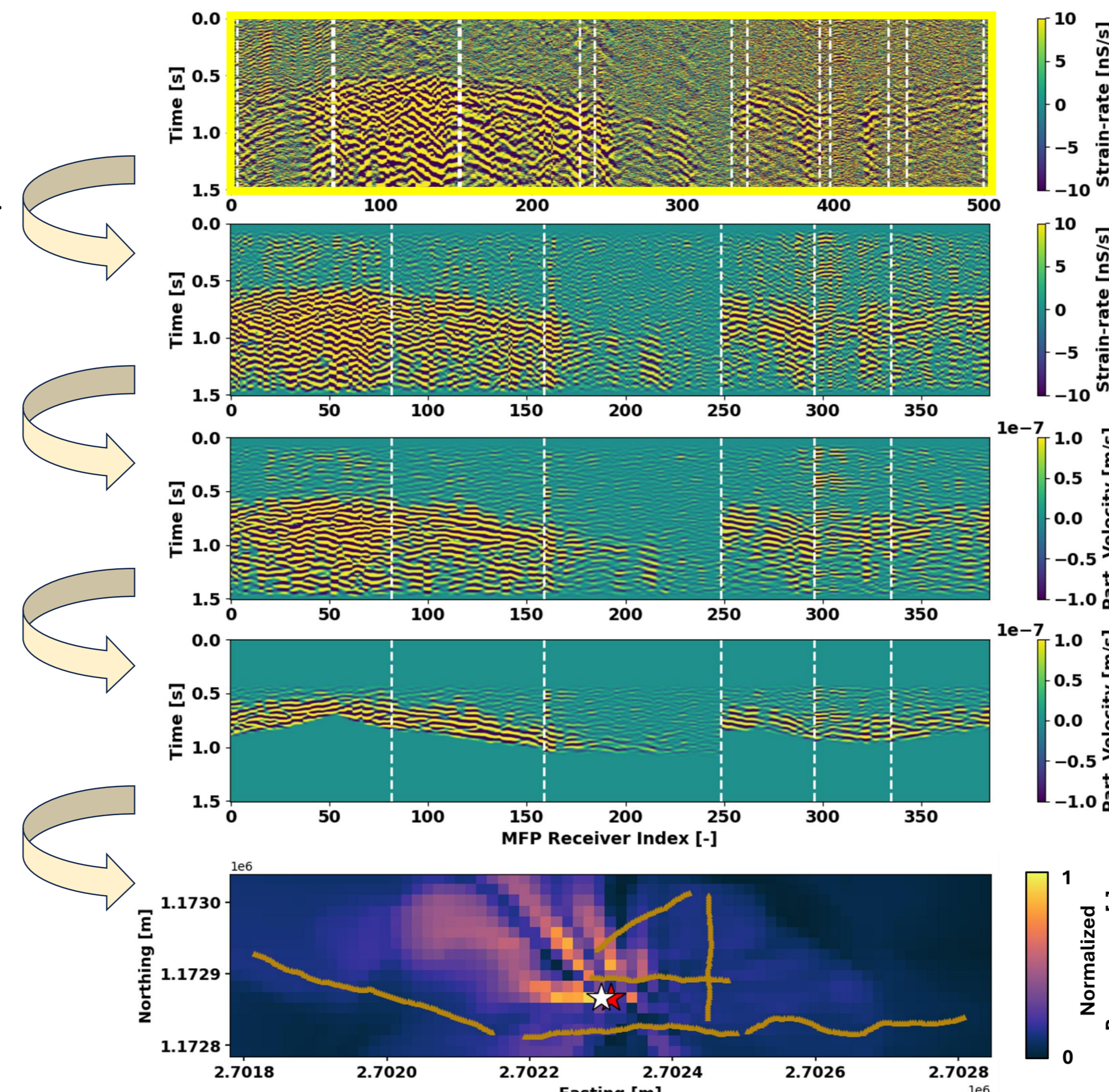
- Enhance body waves

Isolate P-wave energy

- Time-domain mask
- Based on velocity model

MFP Localization (3D)

- Input: P-wave model
- Extensive benchmarking



Key points

First large-scale application of DAS for microseismic slope instability monitoring

- Established and localized a seismic event catalogue consisting of 1277 local events
- Spatial distribution reveals several clusters aligning with known tectonic features
- Temporal analysis highlights three seismicity phases including spatial migration patterns