Microseismic monitoring of storage sites

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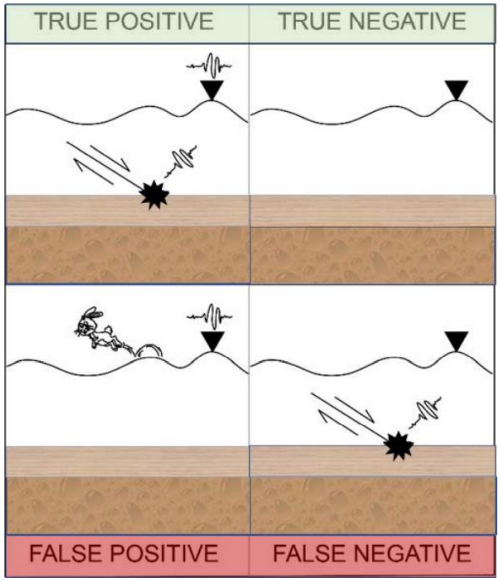
ACT knowledge sharing workshop
Paris, 5. October 2023

Main objective

Progression of microseismic monitoring technologies for seal integrity verification in CCS to become more

- robust
- cost-effective
- publicly accepted

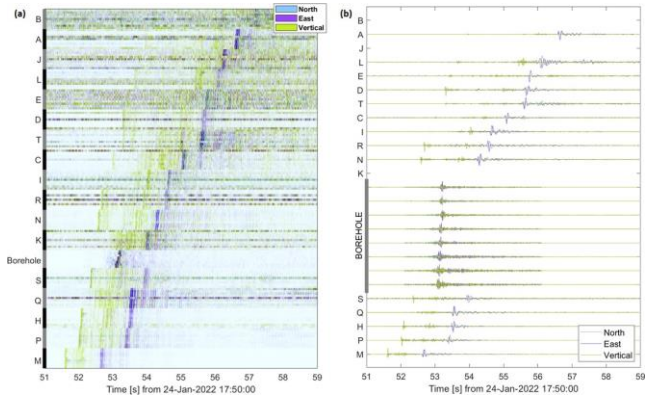


https://ensure.norsar.no/

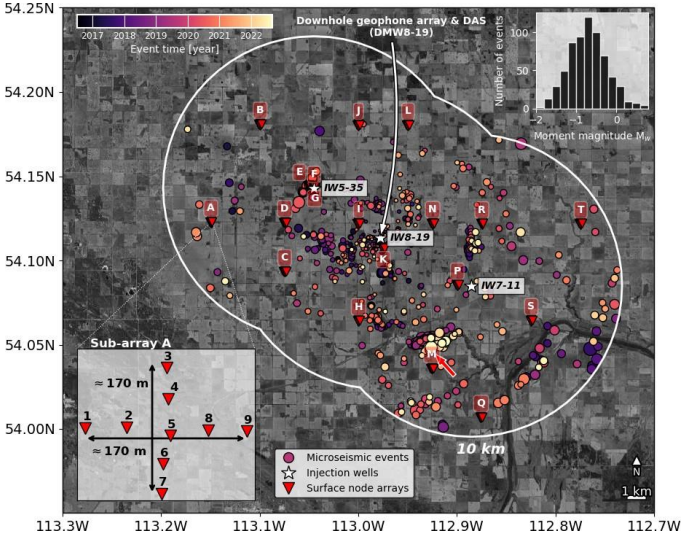
Project highlights

Combining and comparing various microseismic monitoring solutions (real data & modelling) highlight benefits and challenges of individual technologies for **detectability** and **locatability** of microseismic events.

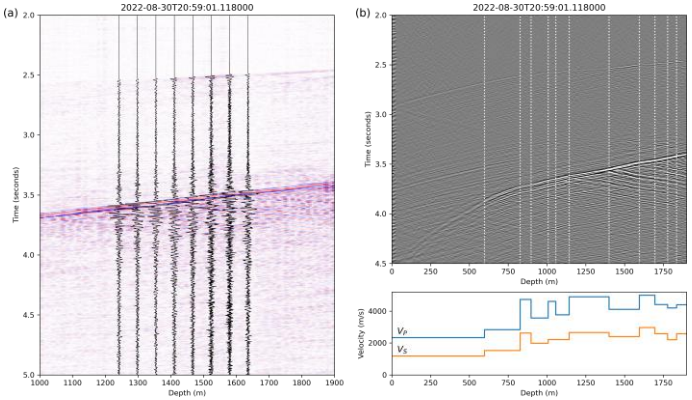
Surface versus borehole



Quest case study site



DAS versus borehole



Goertz-Allmann et al. (submitted to IJGGC)

Project highlights - detectability

Borehole:

- High SNR: good detectability

→ Used as ground truth event catalog

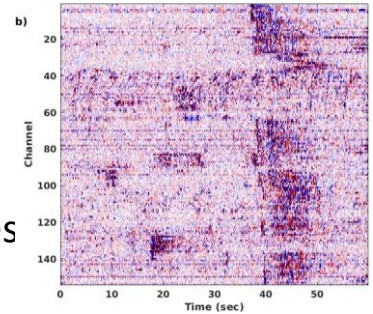
Surface nodes:

- Low SNR
- Attenuation
- Requires advanced pre-processing/filter techniques

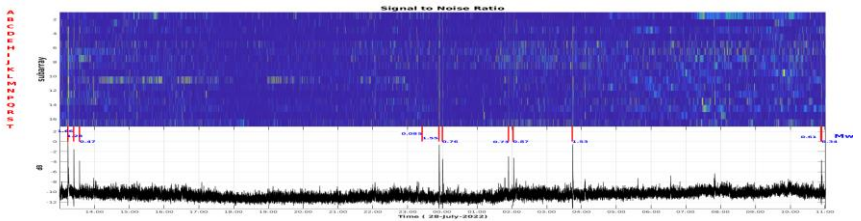
DAS:

- Higher instrument noise
- Weak P-wave
- Densely sampled along fiber → comprehensive picture of complex wavefield

DAS as viable source of high-quality monitoring data

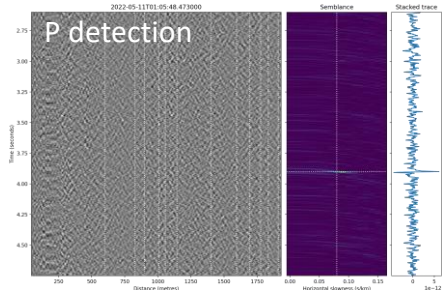


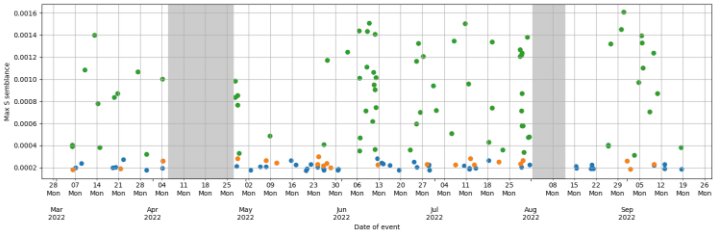
With advanced processing we can improve detectability



- Most events can be detected at surface
- But: high false detection rate

semblance stacking to detect events





- About 50 % of events detected at DAS

Project highlights - locatability

Borehole:

- Poor azimuthal coverage → large uncertainties in event locations

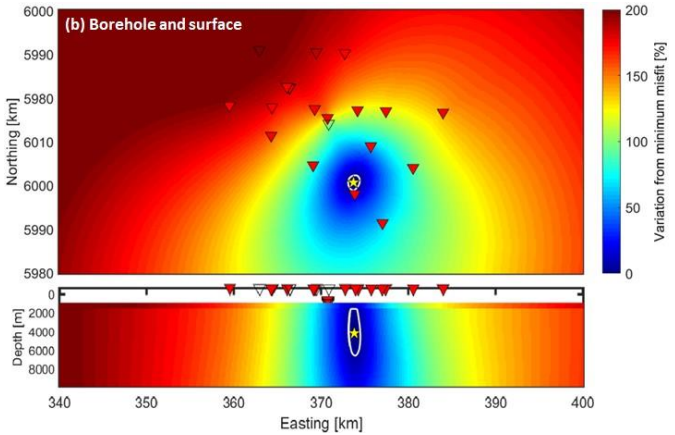
Surface nodes:

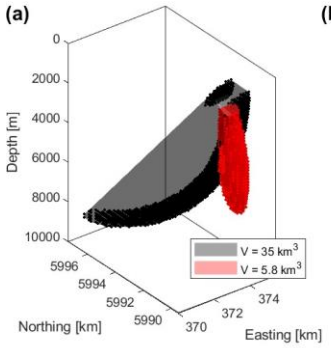
- Improved azimuthal coverage

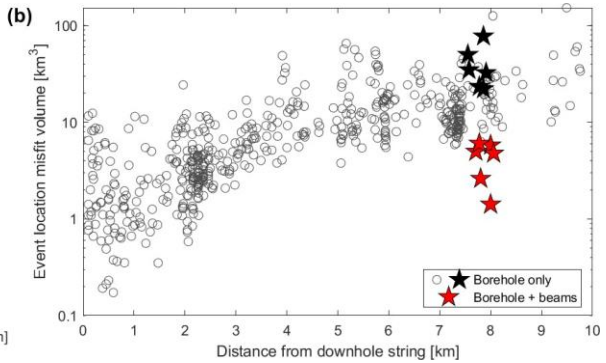
DAS:

- Can only locate events with additional directional info from geophones but reduced event depth uncertainty

Reduced location uncertainty by combining data







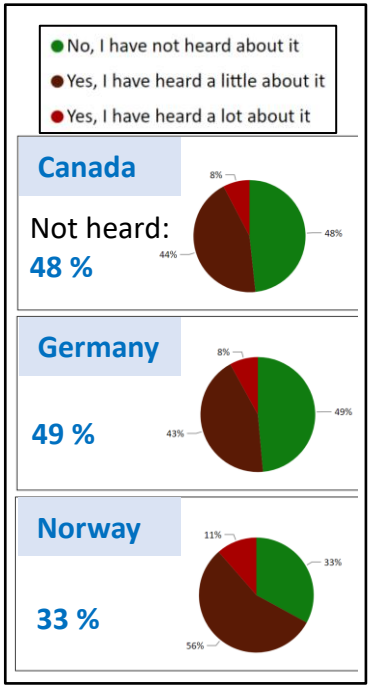
Project highlights – Public perception

- Most comprehensive research effort on understanding public views of CCS to date.

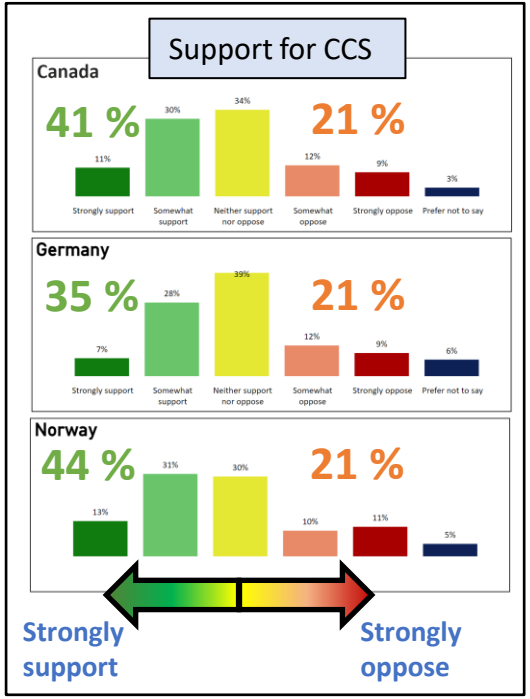
Objectives

1) Can the public support or even accept CCS to reduce CO_2 emissions?
2) What factors matter to public acceptance & perceived fairness of CCS?

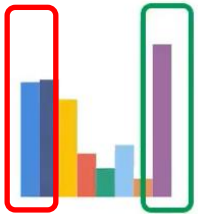
- Large public surveys & economic experiments in 5 countries (N > 5,000).



- Many have not heard about CCS.
- Majority supports CCS.
- Most rate risk of induced seismicity low but majority wants to mitigate its risk.
- More trust in environmental & independent organizations rather than industry & politicians
- All countries are critical towards importing CO_2.



Norway



Overall safety of individual CCS projects

- Specialized independent oversight bodies
- CCS facility operators & governmental energy regulator

Expected impact

- Facilitation of storage verification by elevating the technology readiness level of microseismic monitoring.
- Verification of DAS-based microseismic monitoring as a viable option for CCS.
- Better understanding of driving factors for public acceptance of commercial applications.
- Learnings from ENSURE are already influencing monitoring plans at Quest and other newer CCUS projects.
- Tools for dimensioning of cost-effective monitoring networks at different sites.

Upcoming workshop on "Public acceptance and communication of CCS"

Date: 15. November 2023
Place: Amsterdam

Thank you for your attention!

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