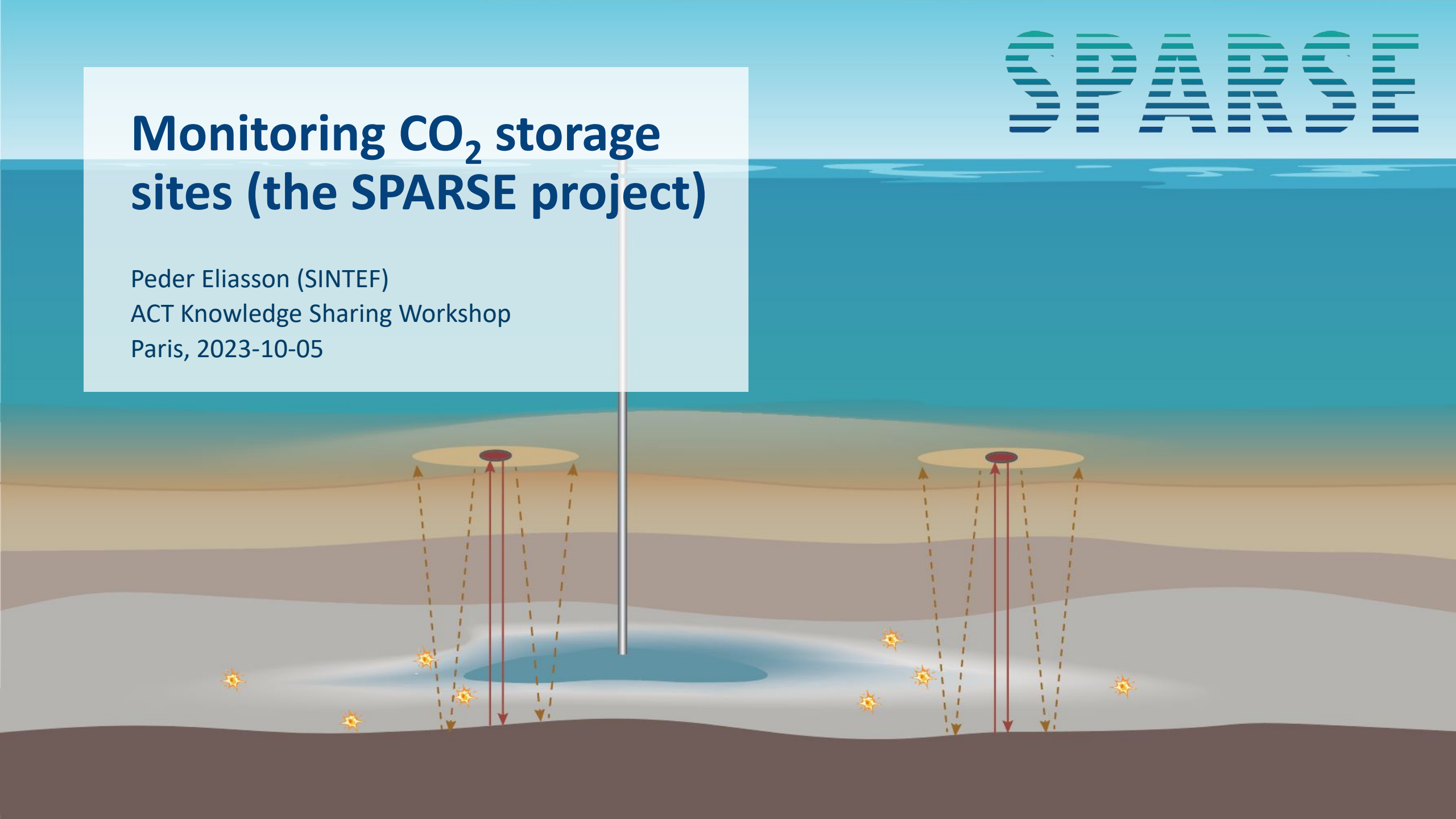
Monitoring CO_2 storage sites (the SPARSE project)

Peder Eliasson (SINTEF)

ACT Knowledge Sharing Workshop

Paris, 2023-10-05



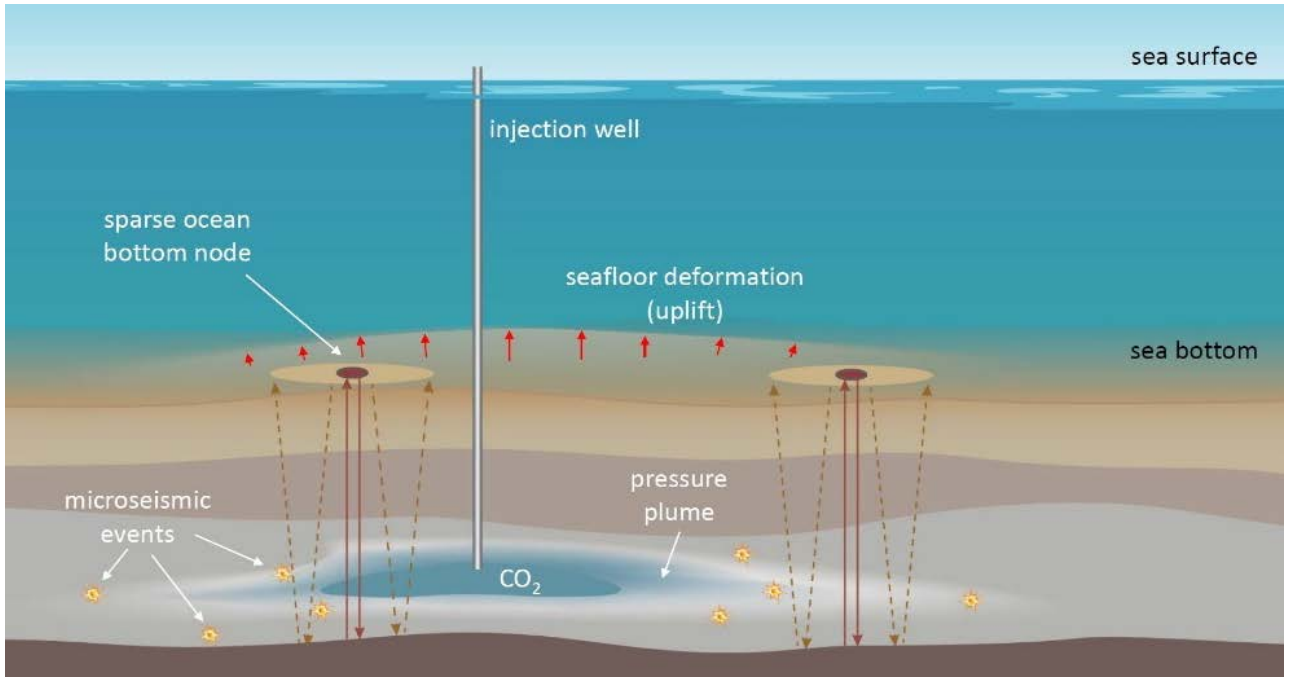
ACT4 SPARSE:

Seafloor Passive-Active Reservoir monitoring using Seismic, Electromagnetics, gravity, and surface deformation

- Aim to enable low-cost, long-term monitoring, thereby facilitating Gt CO_2 storage
- SPARSE background monitoring
  - Node-based conformance and containment monitoring
    - Sparse data, sparse nodes
    - May trigger target-oriented active surveys when needed
    - Reduce / remove need for conventional active surveys
- Main requirements:
  - Extract sufficient information from sparse data for detection and quantification
    - Track pressure, saturation, stress and strain changes
  - High repeatability
  - Low-cost installation, operation, maintenance over decades
    - Solutions must be practical

Budget: ~2.36 MEuro
Duration: 1/7 2023 – 30/6 2026
Project coordinator: SINTEF (Peder Eliasson)

HyFold Technology Inc

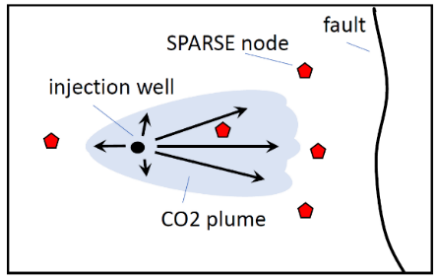


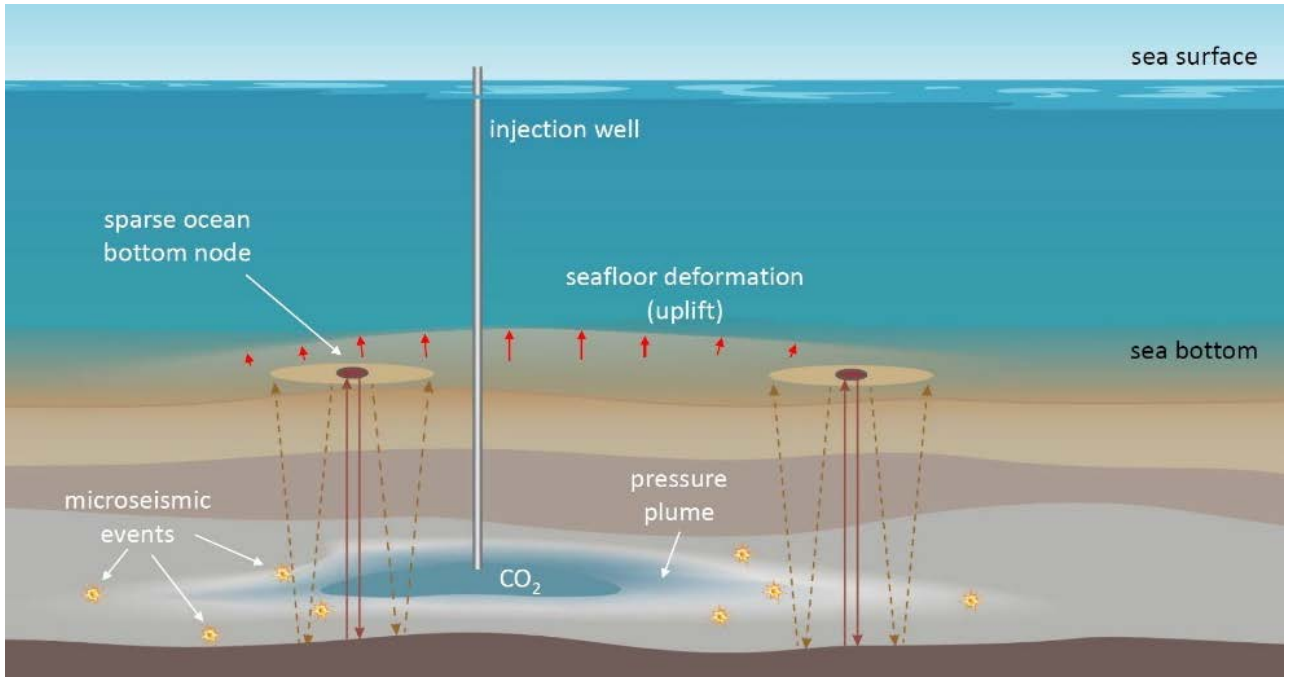
ACT4 SPARSE:

Seafloor Passive-Active Reservoir monitoring using Seismic, Electromagnetics, gravity, and surface deformation

- Key targets:
  - Establish principal node design
  - Quantify key parameters and automatically assess conformance from sparse data
  - Determine technical requirements for implementation of sparse nodes
  - Assess performance of sparse monitoring at CaMI.FRS test site
  - Test sparse monitoring concept using models / data from large-scale storage projects.
- Expected outcomes:
  - Geophysical toolbox for SPARSE multi-physics monitoring
  - Conformance toolbox
  - Recommendations for technical design and implementation
  - Workflow for designing optimum sparse monitoring system
  - Design of SPARSE monitoring system for, e.g., an NCS CCS license

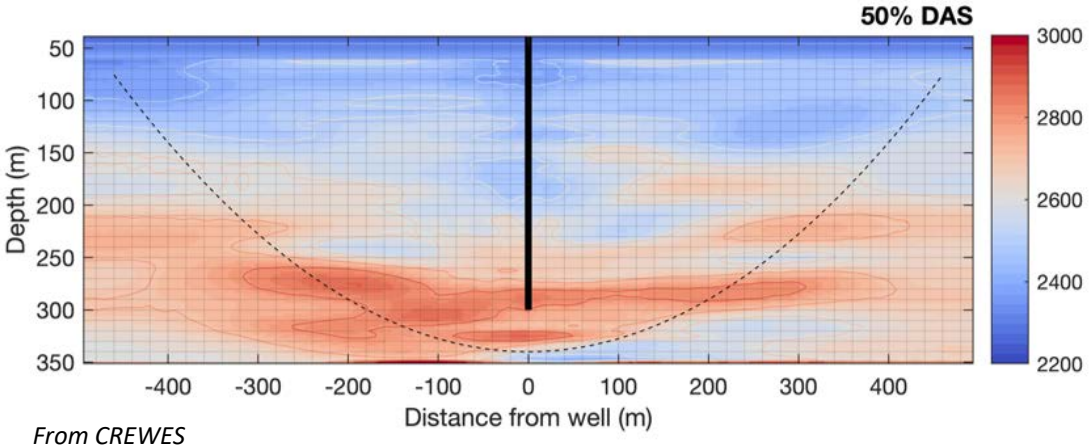
Requires full integration and optimization of all components during the design process!



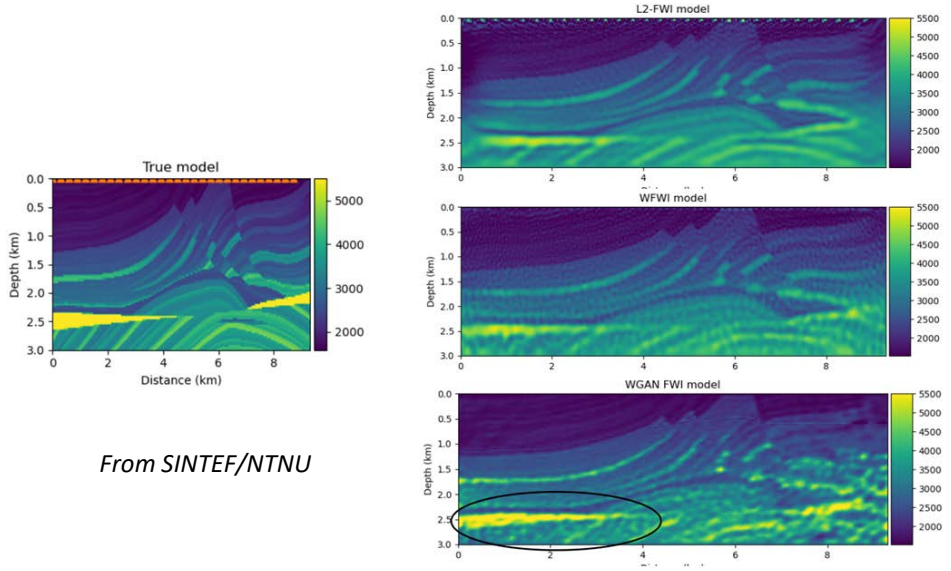


Need for research and innovation

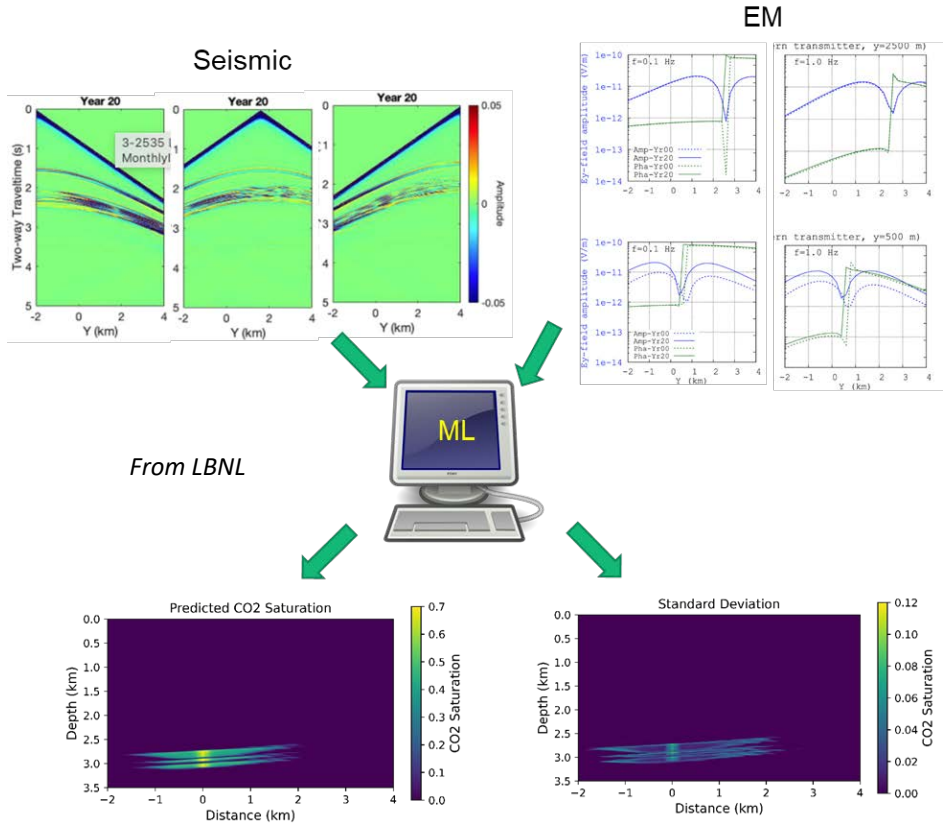
- The SPARSE project will specifically work to innovate and advance the following topics that are vital contributions to achieving the main goal:
  - Sparse multi-method geophysical monitoring and quantification
  - Automatic conformance evaluation
  - Optimum sparse long-term low-cost monitoring design (see next slides)



From CREWES



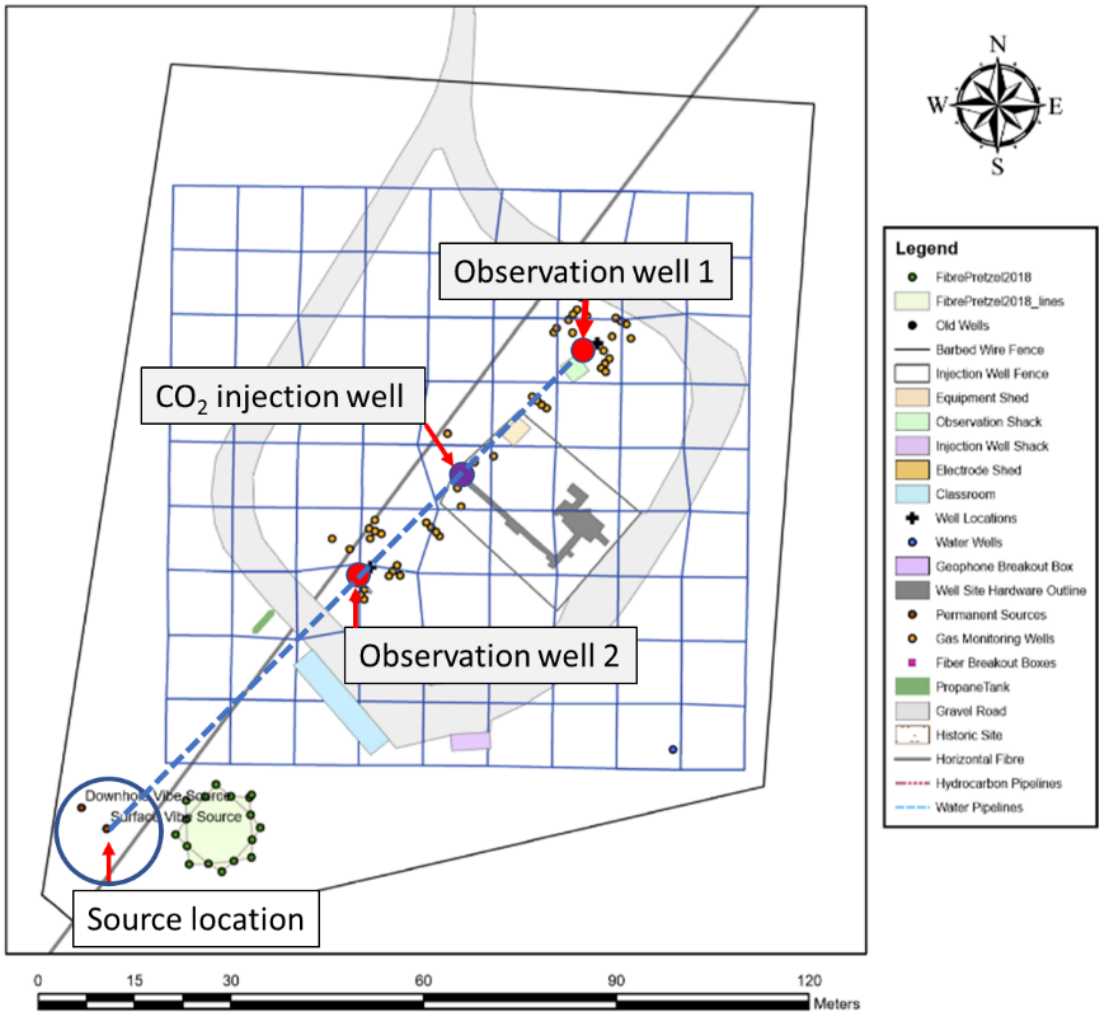
From SINTEF/NTNU



From LBNL

First results: Permanent source acquisition tests

- Field testing of sources and deployment
- Conducted at CaMI.FRS site in Canada
- Installation modes (e.g., steel helical piles)
- Different source types
  - Orbital vibrators
  - Vibrators
  - Thumper source
  - HyFold plasma source



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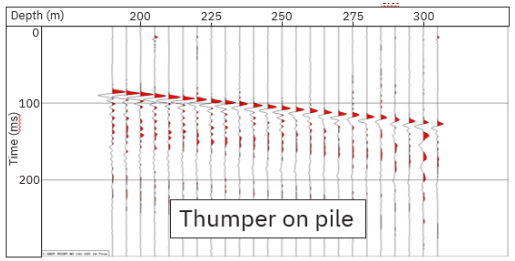
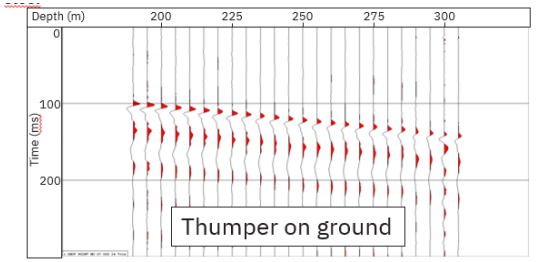
Fiberglass shelter for instrumentation

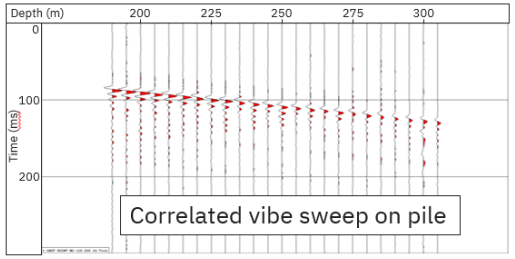
Hyfold bolted to pedestal (seen from above)

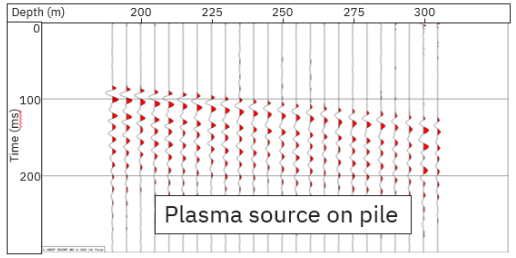
FIG. 2. The USAInc compressed nitrogen accelerated weight-drop source as delivered.
Lawton et al., 2013

Kevin Bertram (CREWES) operating the thumper at CMC's Newell County Facility



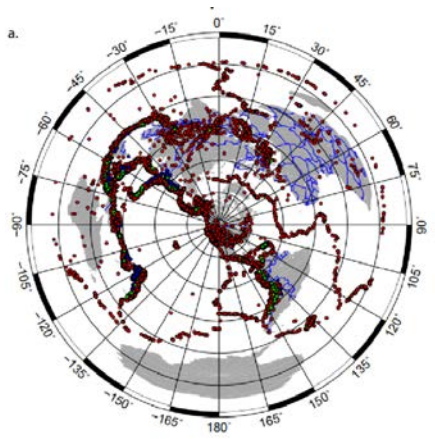


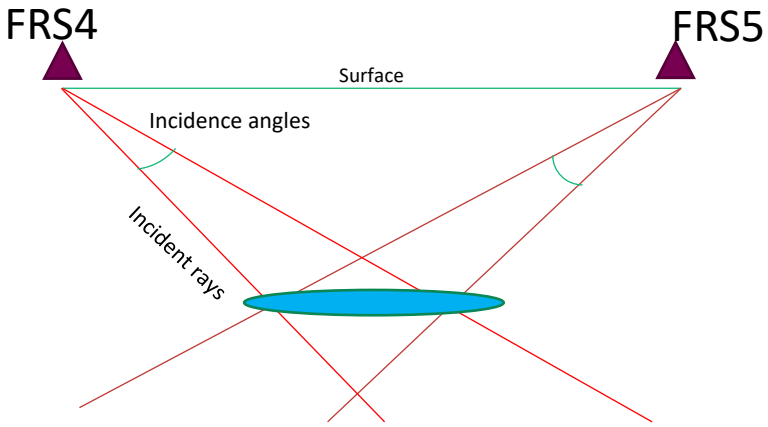


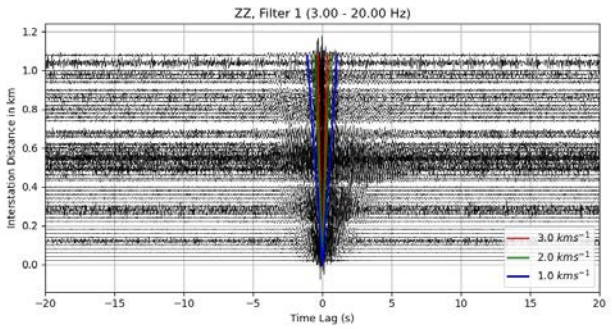


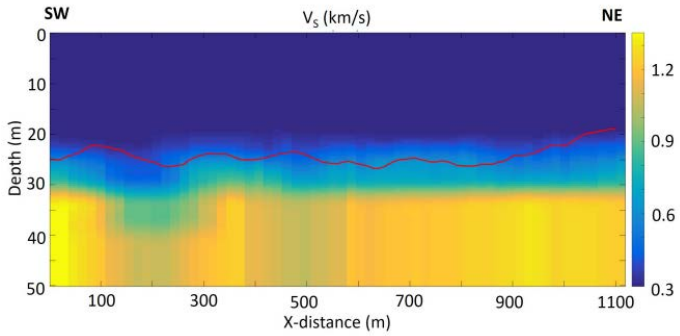
First results: Investigating use of passive data for SPARSE monitoring

- Initial tests investigating the feasibility of using teleseismic data and ambient noise for low-cost SPARSE monitoring
- Data from CaMI.FRS, Canada
- Promising inital tests at CaMI.FRS using teleseismic events from Northern China and Chile
- Testing of use of ambient seismic noise ongoing









Acknowledgements

This work has been produced with support from the SINTEF-coordinated ACT4 SPARSE project (Project No. 340953) funded by RCN (Norway), Gassnova (Norway), DOE (US), and ERA (Canada). We also acknowledge industry partners Horisont Energi and Neptune Energy for their contributions.