Enabling CCS monitoring in the UK using an agile spot seismic operational model on the Poseidon project

SpotLight
The CCS Surveillance company

Carbon Catalyst

Harbour Energy

Perenco

Organiser
SPE Aberdeen Section
Solutions. People. Energy.

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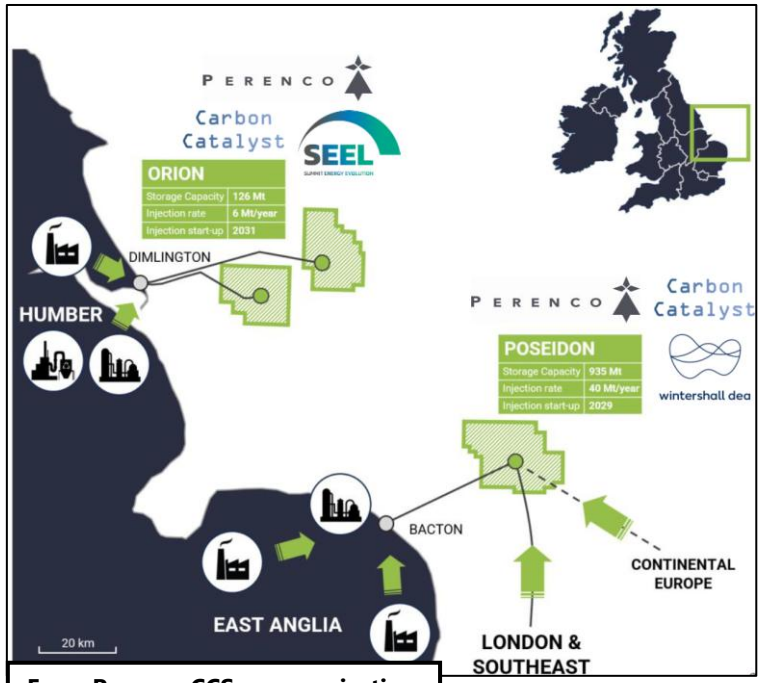
Poseidon project: An ambitious project

- This pionner project is the first CO_2 injection in the UK and has been performed by a joint venture of Perenco, Harbour Energy and Carbon Catalyst.

- Poseidon project is situated approximately 60 km East of Norwich and will be injecting in the depleted gas Leman field, the largest gas field in UK North Sea.

- Why ambitious ? With the net zero goal for 2050, the United Kingdom have set high standards with a goal of 100 millions tons of CO_2 being captured in the subsurface.

- Poseidon Project aims to capture 10 millions tons per annum in 2030 and up to 40 millions tons per annum in 2040.

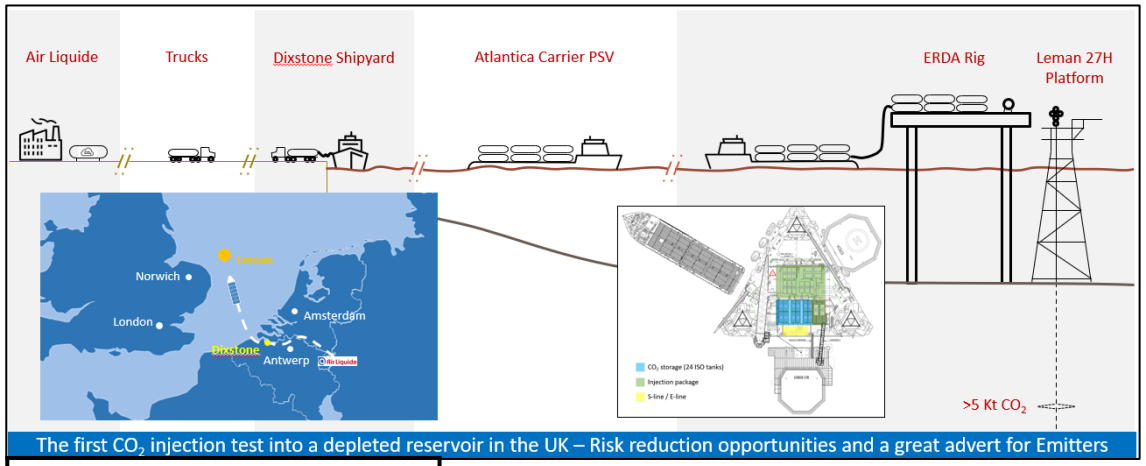


From Perenco CCS communication

Link to Perenco CCS video: https://youtu.be/I_RTCwBKBk8

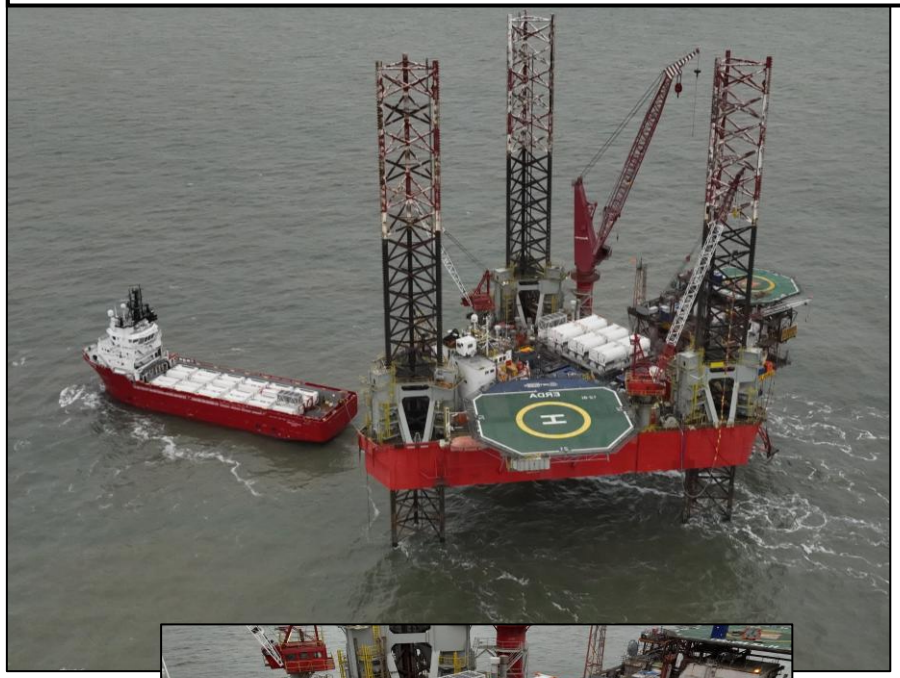
Poseidon project: Test Injection Phase

- This injection phase has been carried out with 15 injection's batches with more than 3500 tons of CO_2 injected in the Leman field.
- CO_2 was carry out by boat and onto the rig to be injected from the recomissioned 27H platform on the Leman Field.
- The MMV plan included VSP & active SpotSeismic previous to injection and during one of those batches.



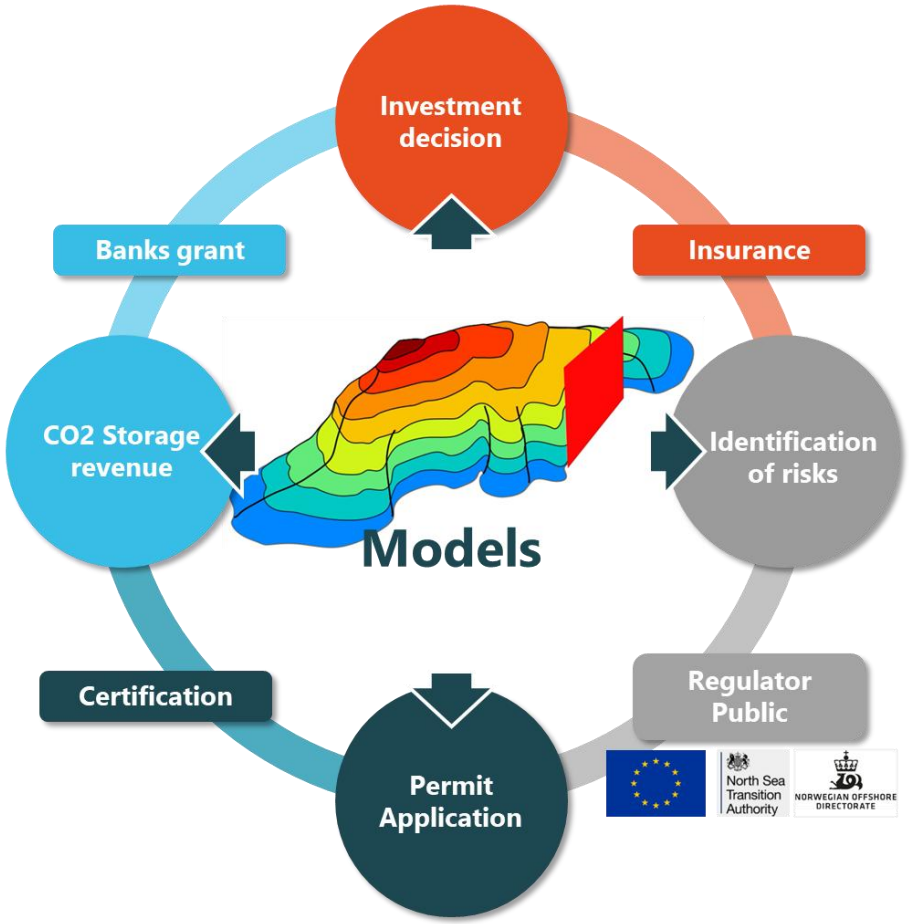
From Perenco CCS communication

ERDA rig attached to Leman 27H platform, from Perenco CCS communication



CO2 loaded on rig, from Perenco CCS communication

MMV plans depend on legislation !



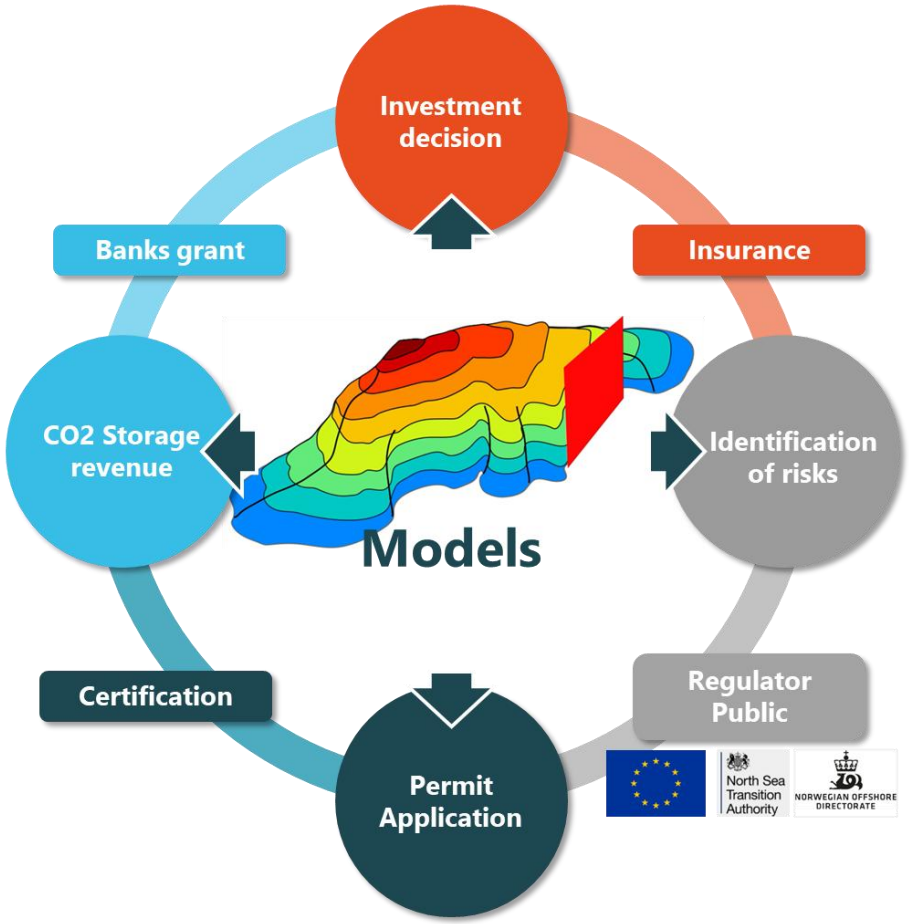
North Sea Transition Authority

Guidance on the content of an Offshore Carbon Storage Permit Applications

The dynamic models used in the CSDP that define the range of predicted plume behaviours, CO_2 injection rates, pressurevolume-temperature and saturation behaviour, and storage capacity should be used as a reference point for applicable monitoring data. The Licensee should outline in the MP the steps they will take to understand the reasons for any deviations from predicted behaviour, if the data gathere and interpreted through monitoring in the injection phase clearly deviates from that predicted, a plan should be in place and detailed here to recalibrate models and generate updated or new hazard scenarios.

MODEL VALIDATION

MMV plans depend on legislation !



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MODEL VALIDATION

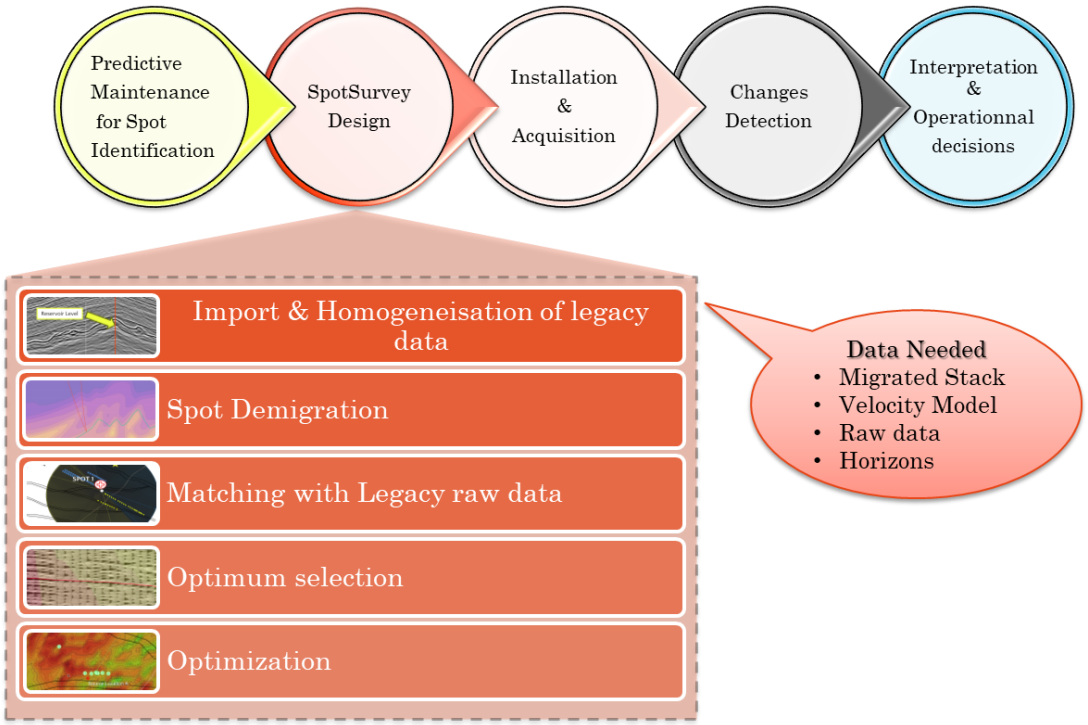
↓

SPOTSEIMIC TO FIT PLAN REGULATOR REQUIREMENTS

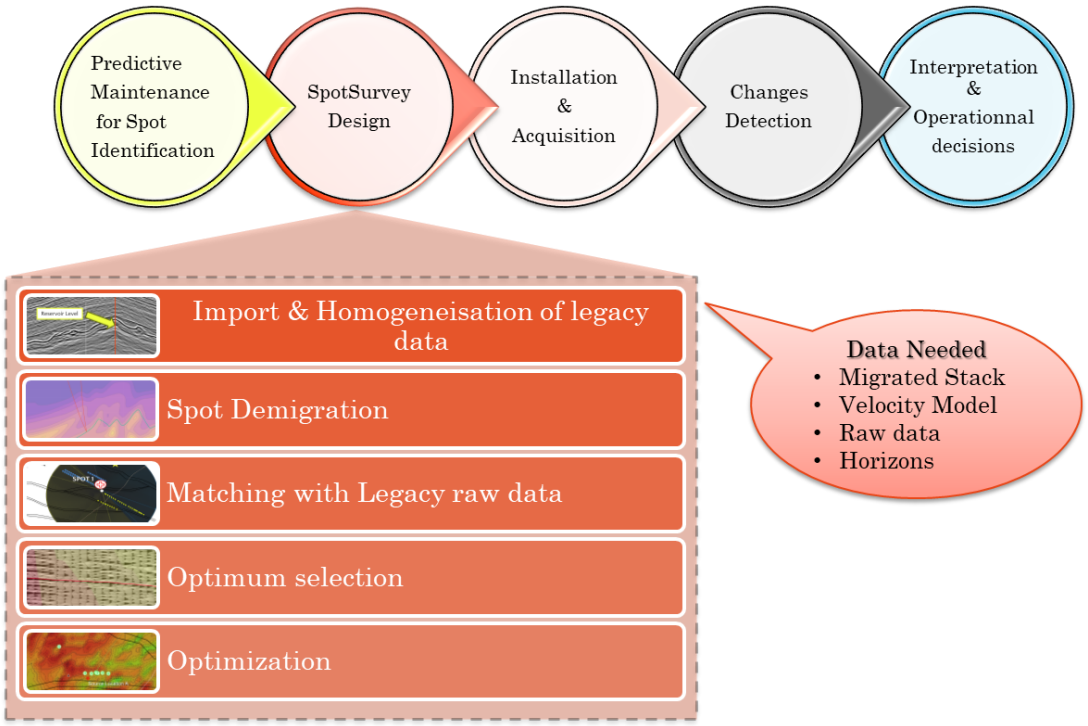
↓

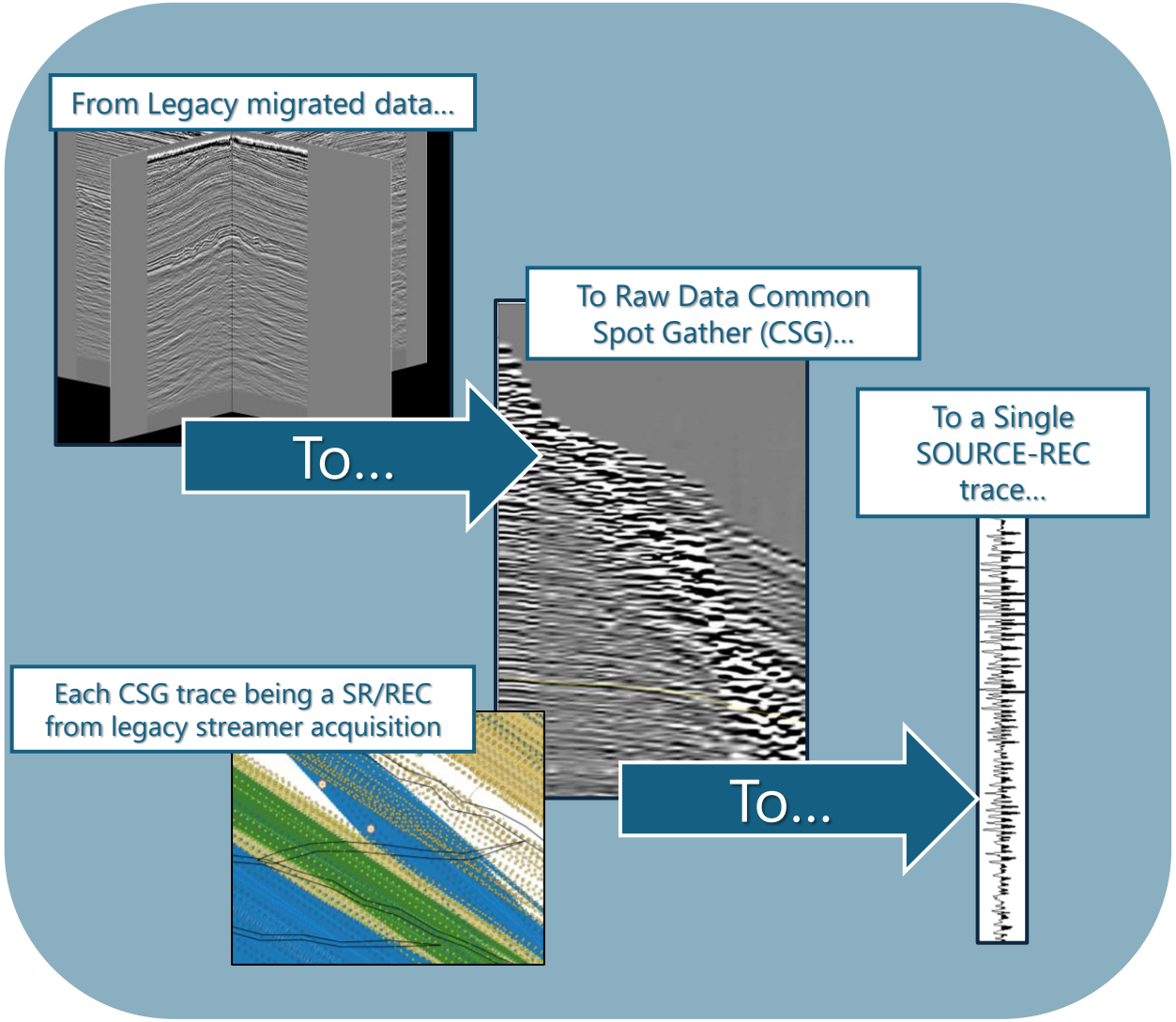
EARLY DETECTION FOR PRO ACTIVE DECISIONS

Spot Concept: a 1D active seismic solution

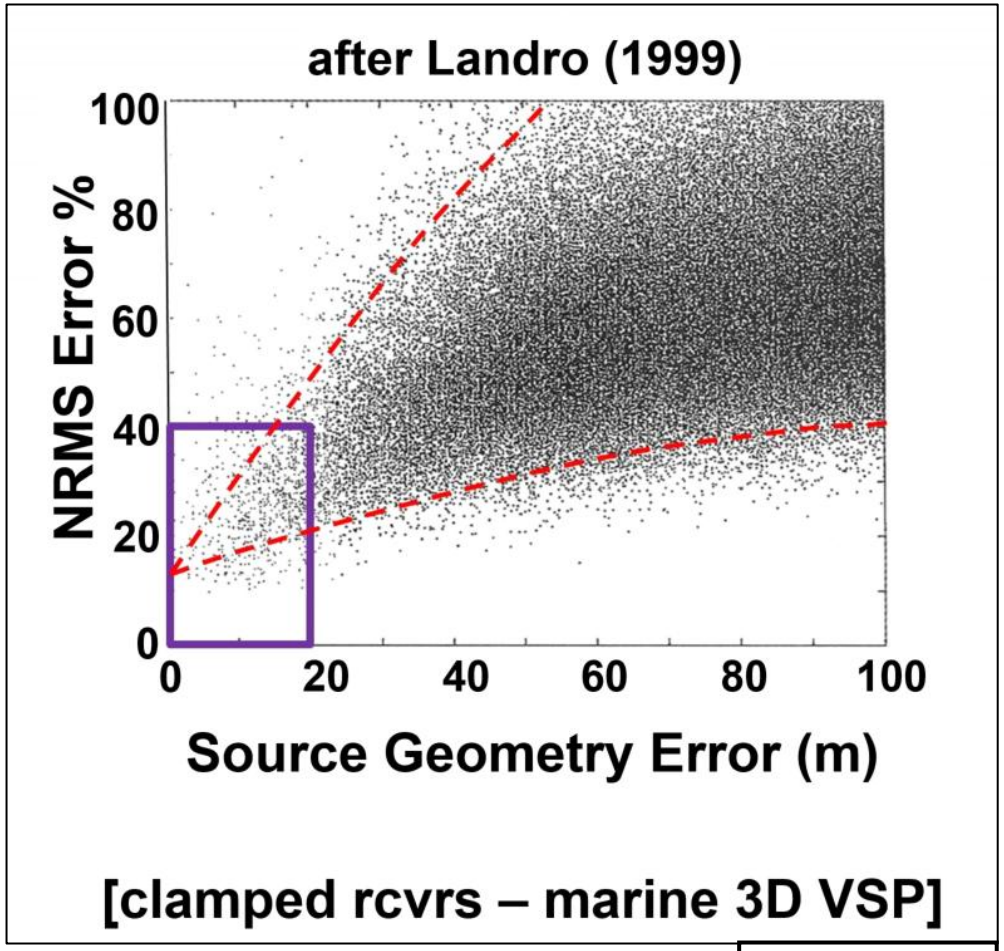


Spot Concept: a 1D active seismic solution

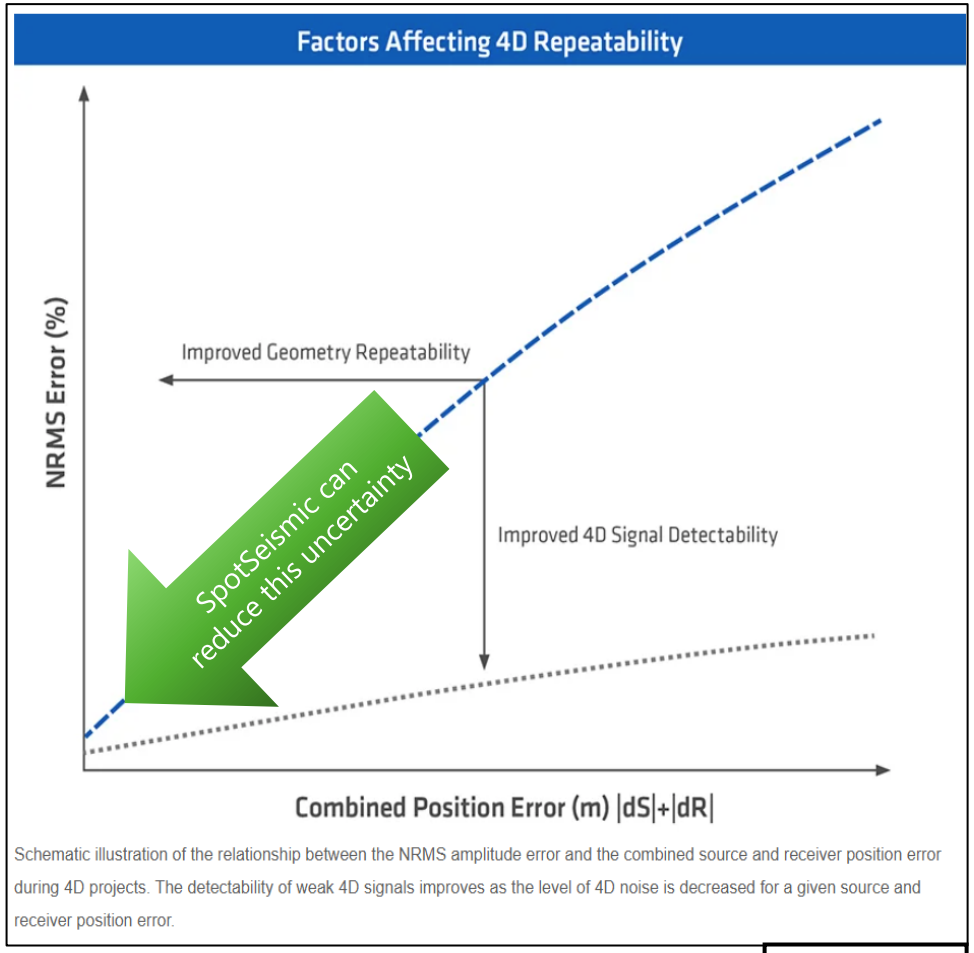




4D metrics … but still valid in 1D!



Mike Jervis & al.



PGS website

Acquisition Preparation

Suppliers | Position | Weather | SNR

Your operational model requires different SR/REC parameters compared to conventional seismic, how do you select suppliers to fit your needs ?

Acquisition Preparation

Suppliers | Position | Weather | SNR

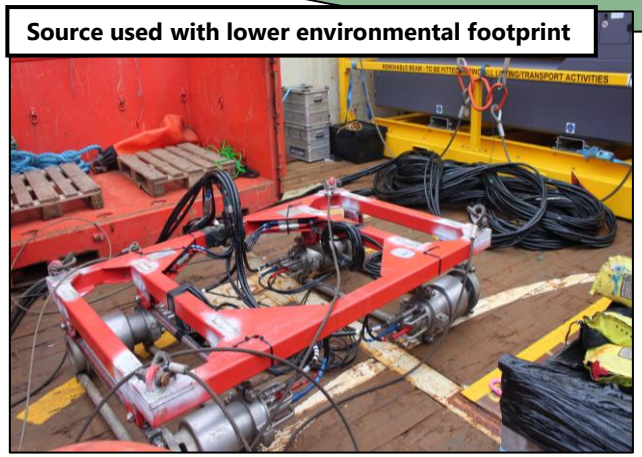
Your operational model requires different SR/REC parameters compared to conventional seismic, how do you select suppliers to fit your needs ?

- Helping during tender phase to select boat, source & receivers suppliers to keep cost low for operator
- Calculating parameters needed to reduce environmental footprint (exp: source power)
- Adapting design from legacy streamer to OBN

Nodes ready to be dropped

Perenco supply vessel, Kingsborg.

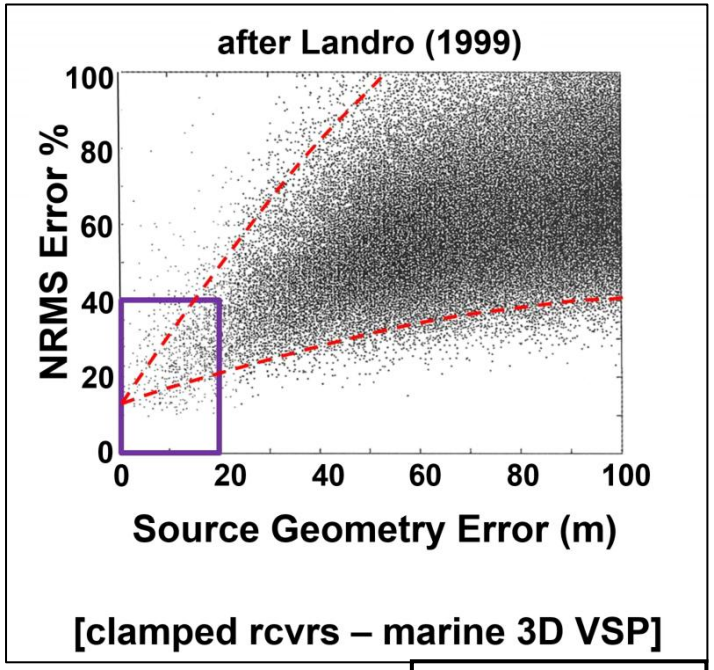
Source used with lower environmental footprint



Acquisition Preparation

Suppliers | **Position** | Weather | SNR

You talk about having 1 trace (1 SR/ 1 REC) but how does it translate in terms of acquisition operations ?



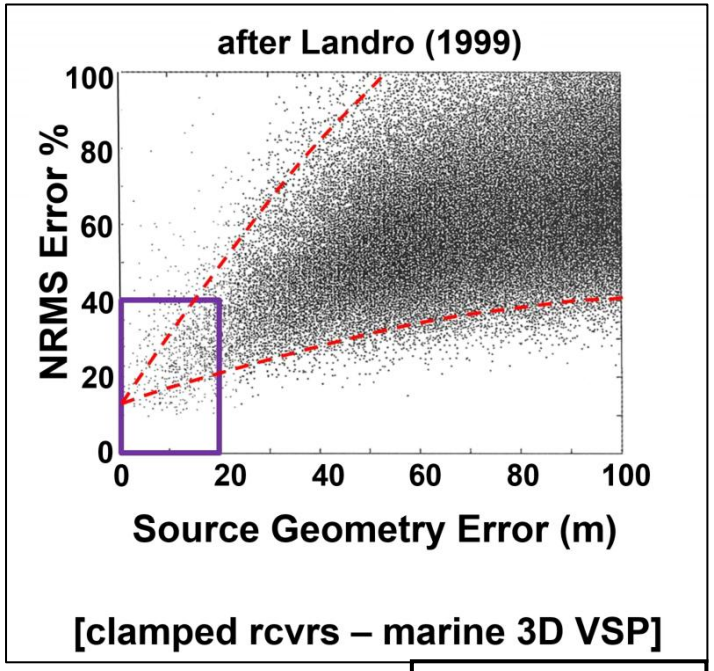
Mike Jervis & al.

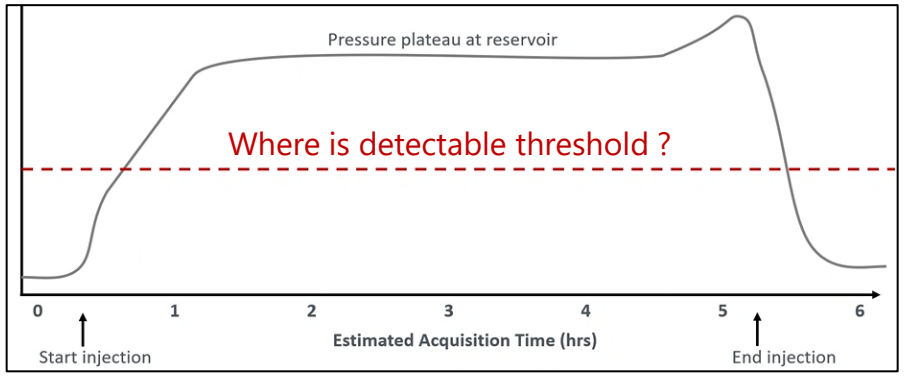
Acquisition Preparation

Suppliers | **Position** | Weather | SNR

You talk about having 1 trace (1 SR/ 1 REC) but how does it translate in terms of acquisition operations ?

- NRMS metrics used in 4D is really sensitive to source & receiver positionning. It will be the same in 1D.
- Acquisition done in synergy with a VSP acquisition.
- Pressure in the reservoir will quickly dissipate & timing was of the upmost importance.





Acquisition Preparation

Suppliers | Position | **Weather** | SNR

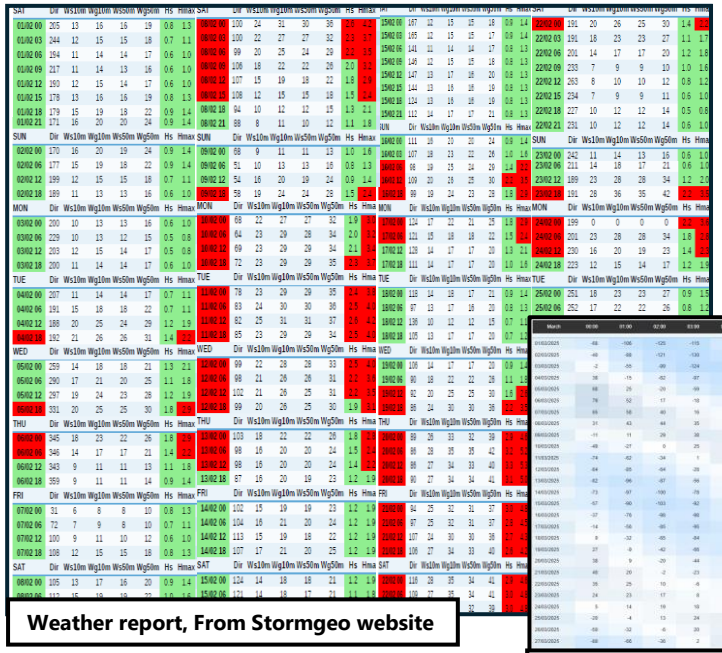
You say it's an agile system to deploy, but how do you manage weather conditions like the North sea in Winter ?

Acquisition Preparation

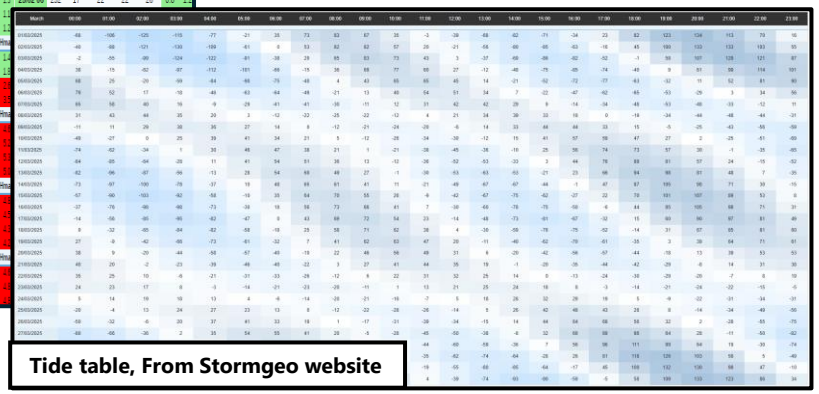
Suppliers → Position → **Weather** → SNR

You say it's an agile system to deploy, but how do you manage weather conditions like the North sea in Winter ?

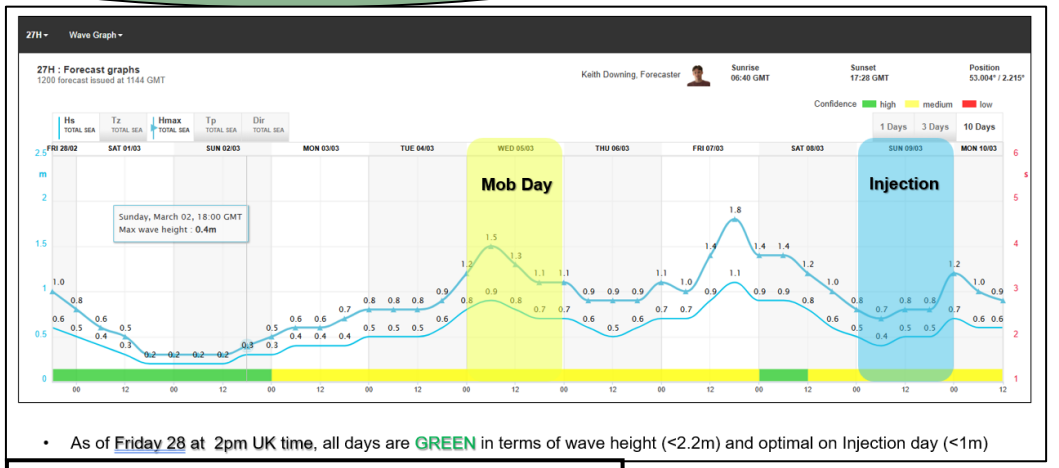
- Having a good weather is not in our control.. But it IS predictable.
- Having contingency plans is key to fit every player needs if decisions have to be made.
- For Spot Seismic acquisition, the less noise induces by weather, the better. Aim is for <2m wave height & avoid any high/low tides.



Weather report, From Stormgeo website



Tide table, From Stormgeo website



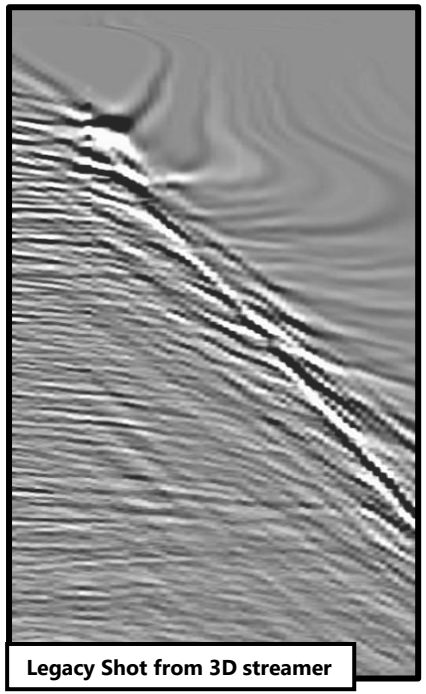
- As of Friday 28 at 2pm UK time, all days are GREEN in terms of wave height (<2.2m) and optimal on Injection day (<1m)

Example of a weather internal report prior to Acquisition

Acquisition Preparation

Suppliers → Position → Weather → **SNR**

Having the same position doesn't mean the trace will be comparable with legacy acquisition parameters, how do you ensure a good SNR ?



Legacy Shot from 3D streamer

Acquisition Preparation

Suppliers → Position → Weather → **SNR**

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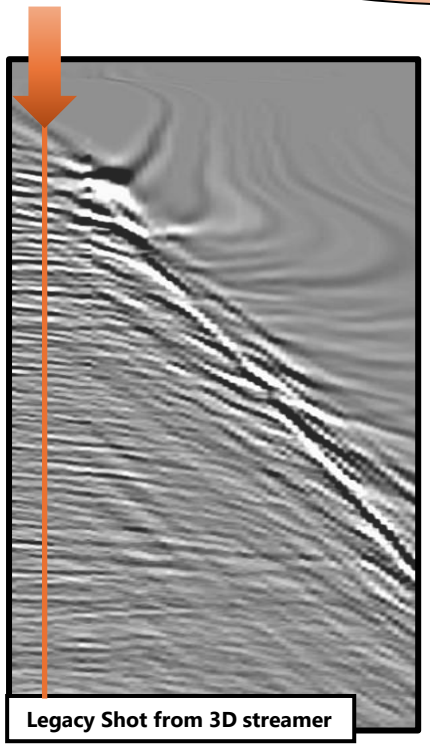
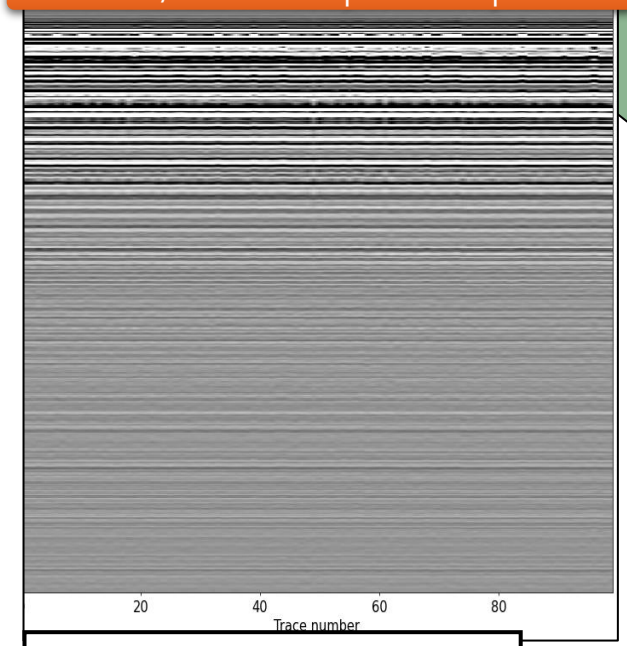


Legacy Shot from 3D streamer

Same SR/REC trace repeated acquisition



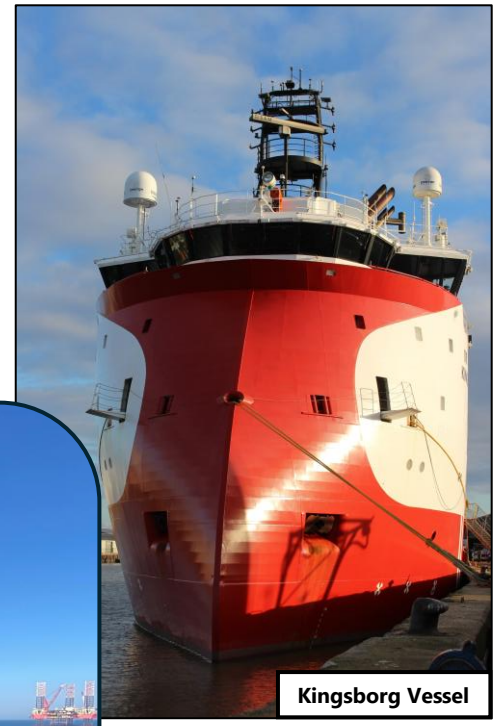
Exemple from SpotSeismic static shot quality

- Operationnal model are different between 3D streamer and an ultra light Spot Seismic design.
- To account for this difference, preparation in terms of parameters & noise source is key.
- Once all criterias mentionned before are met, the last tool used is the temporal stack to have a equivalent or higher SNR compared to the legacy trace.

Acquisition time : A great success !


Leman 27H, End of October 2024

Acquisition, End of October 2024


Kingsborg Vessel

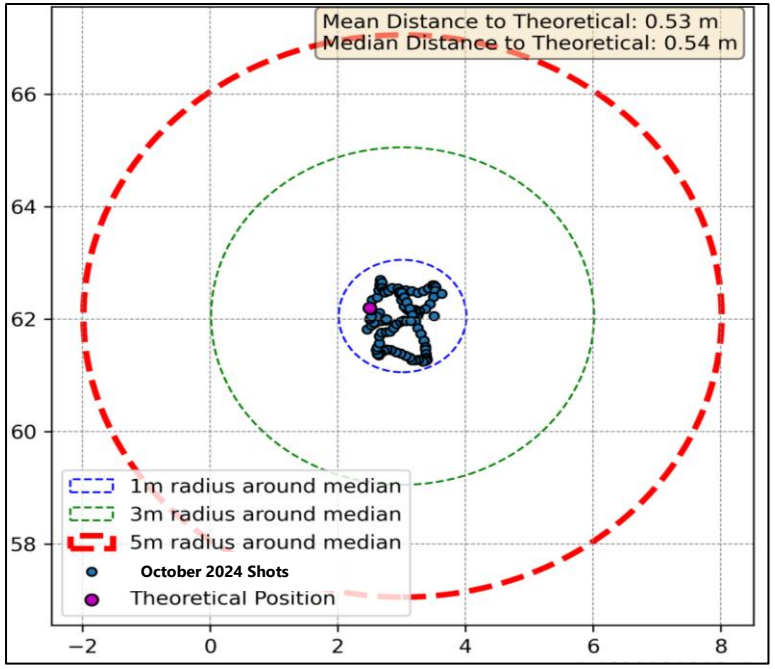

Acquisition, Mid March 2025

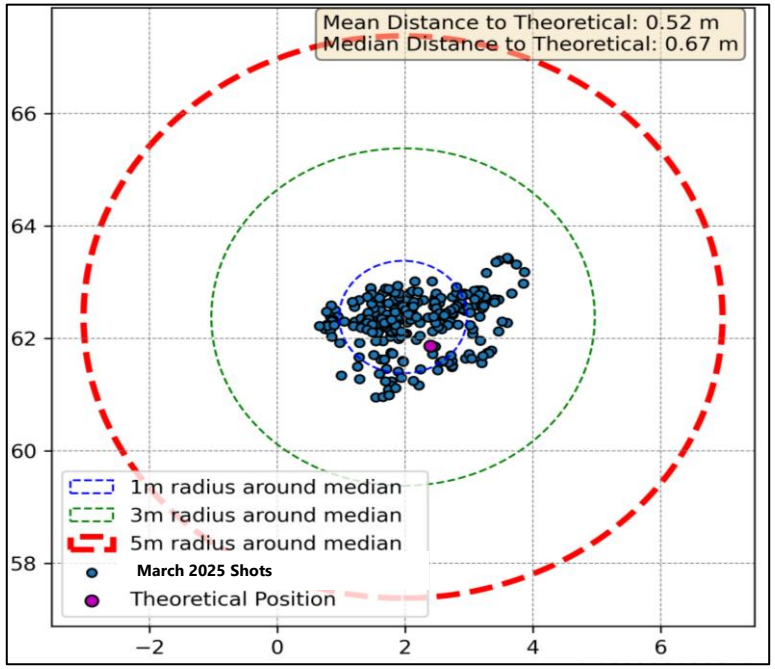

Acquisition, Mid March 2025


Node dropping, End October 2024

First results out !!

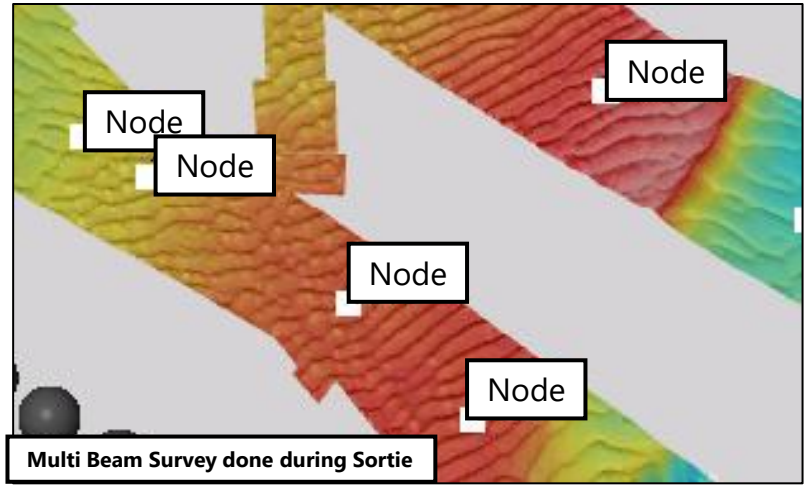
Source Positionning Static Shot in October 2024





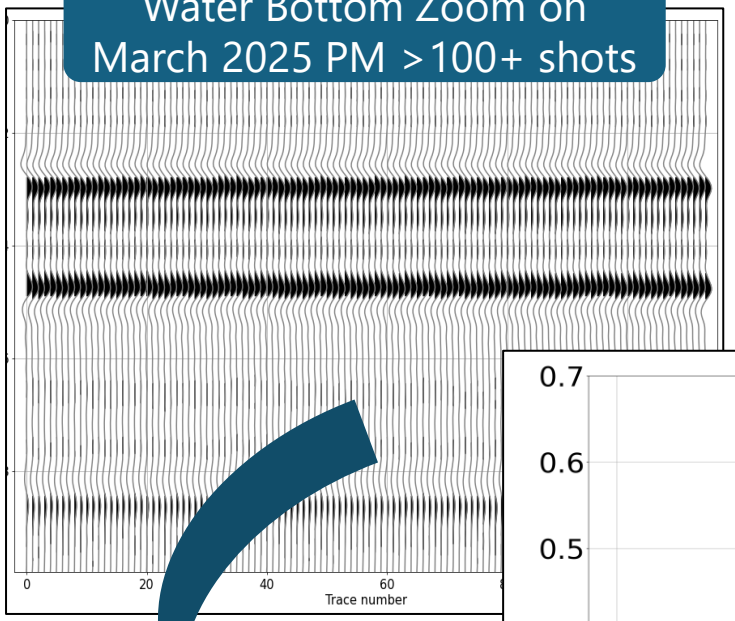
Source Positionning Static Shot in March 2025

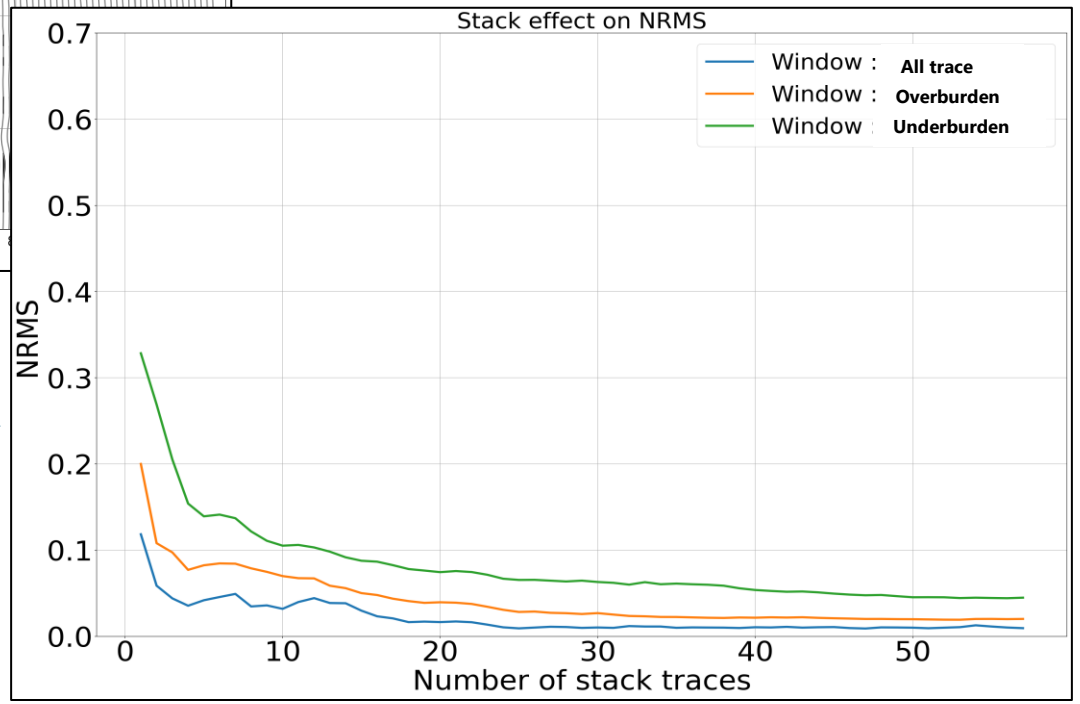
OBN Positionning check, <1 m at each Sortie

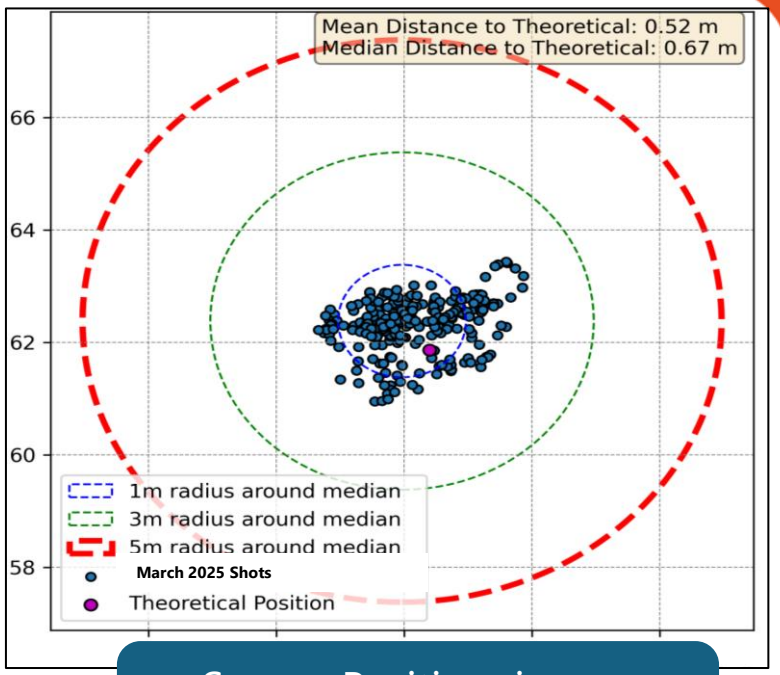


An impressive offshore repeatability !

Water Bottom Zoom on March 2025 PM >100+ shots







Source Positionning on March 2025 >100+ shots

NRMS as low as 2% on the full trace when reaching a temporal stack of 30 traces !

Conclusion

So was this SpotSeismic a good agile solution for enabling CCS monitoring on Poseidon Project ?

March 20225 Acquisition Final Photo

YES it was !

- Designing & bringing to life a ultra-light and focused active seismic monitoring is possible.
- Preparation is key and working with every party involved is vital.
- Data can be acquired during winter in North Sea while having great repeatability if the all criterias mentionned are met.

Carbon Catalyst · PERENCO · Harbour Energy · SERCEL · VSProwess · Baker Hughes · SEEL SUMMIT ENERGY EVOLUTION · Hydroconsult · ROYAL WAGENBORG

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The CCS Surveillance company

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