INNOVATIVE ENOS SOIL GAS MONITORING TECHNIQUES

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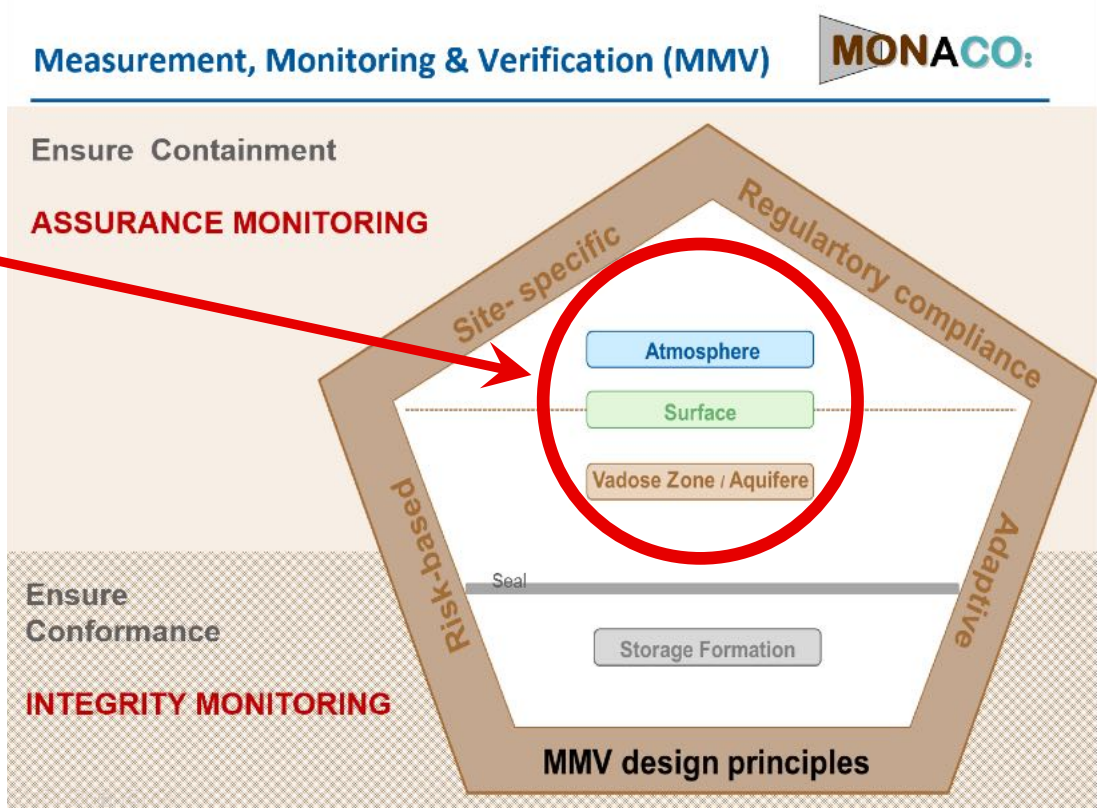
Why are we carrying out surveys?

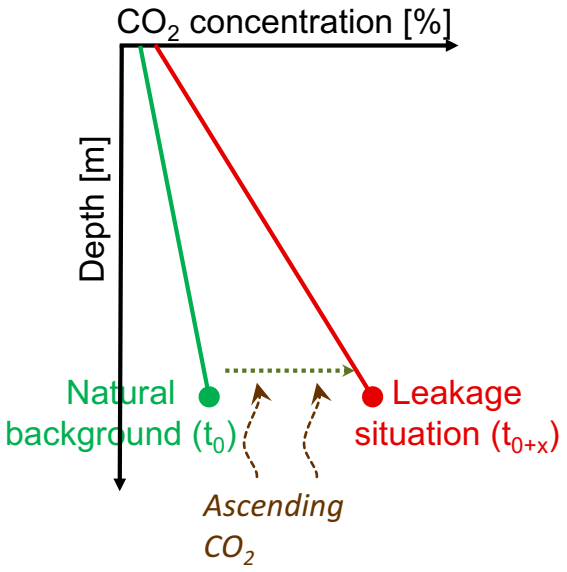
- Part of storage site integrated assurance monitoring
- Survey the near-surface environment as ultimate interface from underground to atmosphere
- Ensure the effectiveness of geological CO2 storage, public health and environmental safety
- Assure regulatory compliances / legal requirements



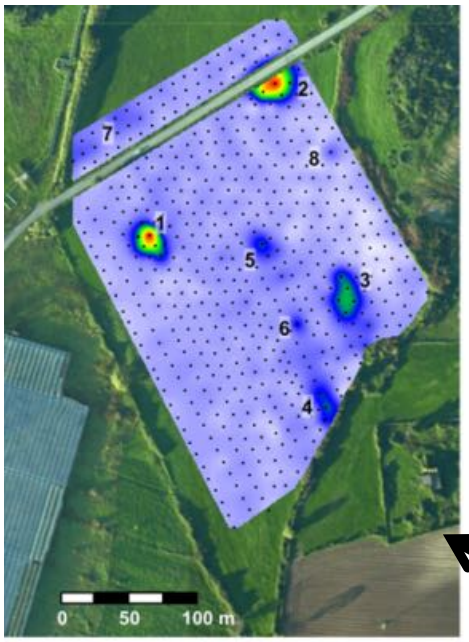
How do you distinguish a CO_2 leak from baseline variability?

Spatial variability

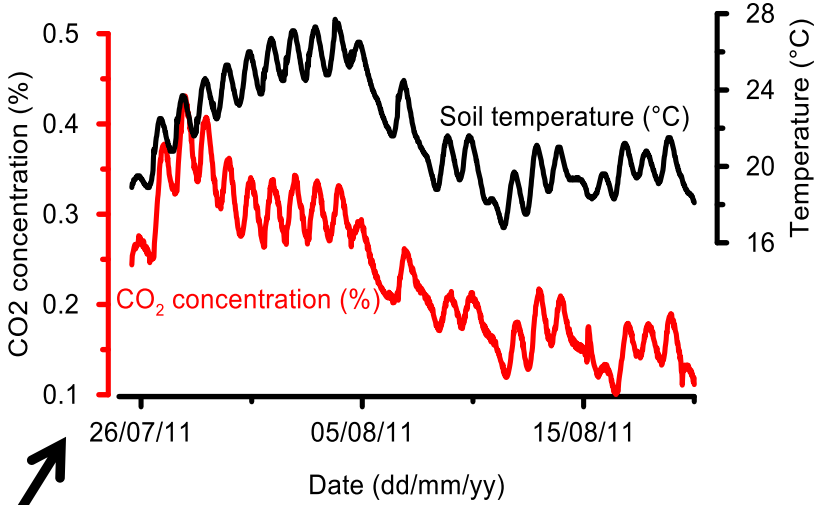
Vertical



Lateral



Temporal variability



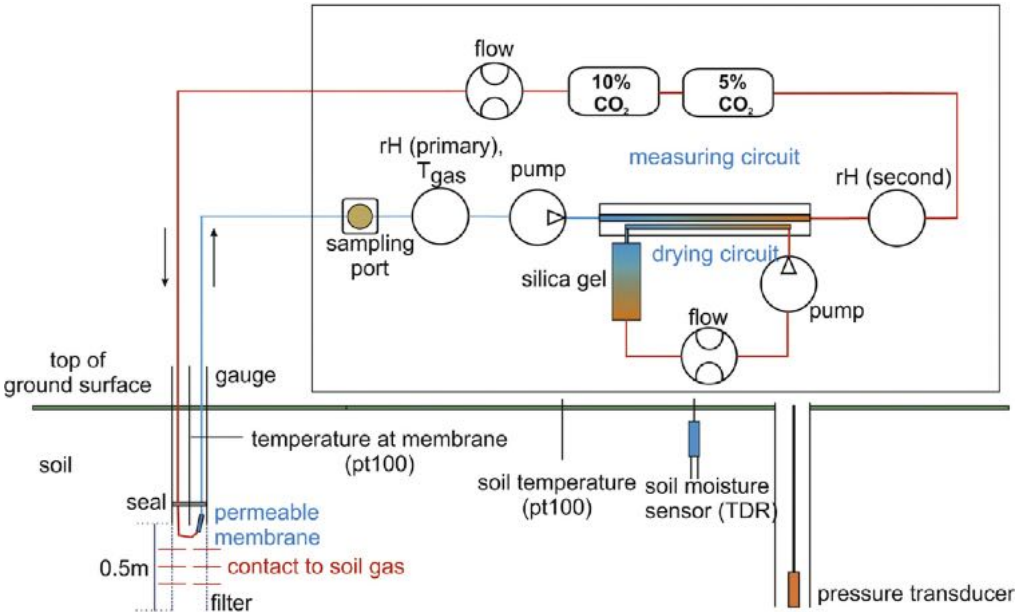
Jones et al., 2014, Int. J. Greenhouse Gas Control, v. 28, p. 300-317, DOI:10.1016/j.ijggc.2014.06.021.

Beaubien 2015. The mapping and quantification of CO_2 leakage and its potential impact on groundwater quality. PhD dissertation. Ca' Foscari University, Venice Italy.

- Soil gas monitoring to show site is not leaking
- Recording soil CO_2 concentration levels and related environmental parameters to examine possible deviations from natural background conditions / trends / values

How is BGR addressing these issues?

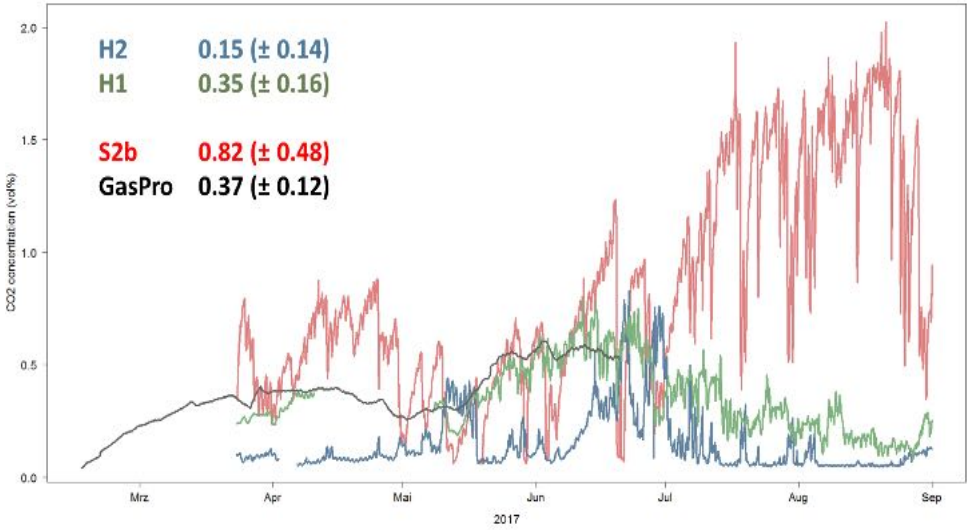
- Custom-made stationary system based on modular concept
- Continuous CO_2 concentration recording (24/7, 5-min-interval)



- Additional environmental and technical parameters for data analysis and interpretation
- Near real-time evaluation possible - data stored locally and transferred via GSM protocol to BGR's home base

What has been achieved by means of the BGR system?

- Ongoing monitoring at pilot site “Hontomín” (ENOS WP1); GTB (UK, ENOS WP3) scheduled for 7/2018
- Monitoring / equipment development at CO_2 seepage sites (e.g. Eger Rift valley, CZ)
- Soil CO_2 baseline monitoring for proposed CO_2 storage complex in Germany and at Ketzin pilot site



ENOS

What are the overall benefits of the BGR system?

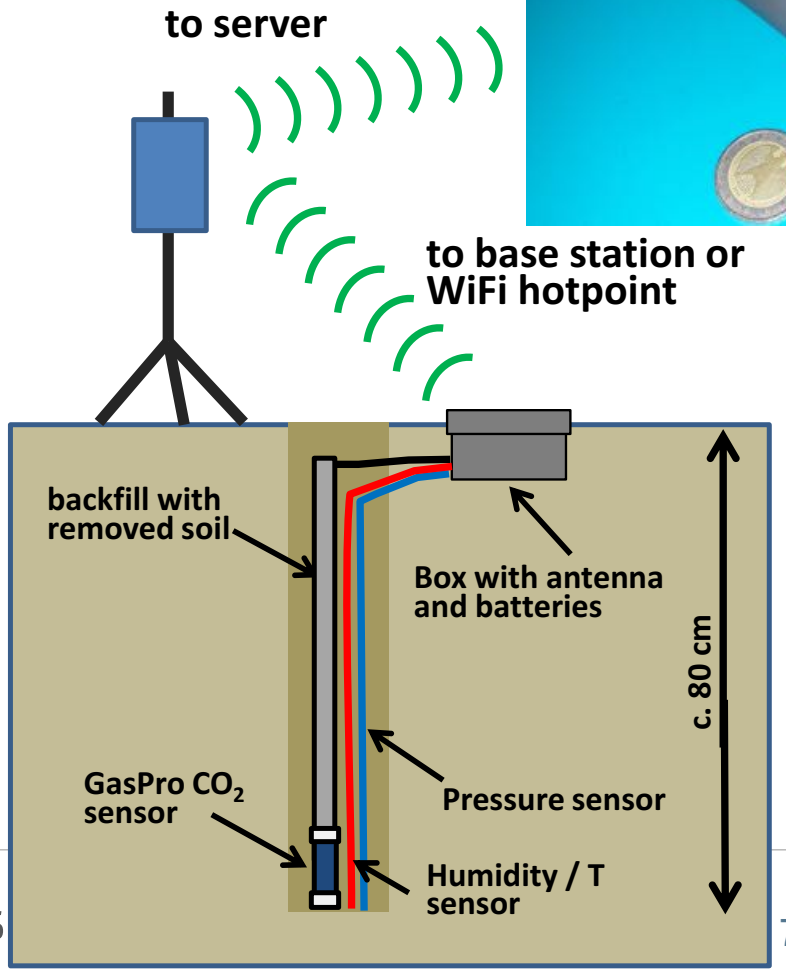
- Several long-term data sets (up to 5 years) obtained from more than 25 different locations
- Functionality demonstrated in operational environment (TRL 7)
- Easily adaptable, robust and reliable

- Low basic maintenance and easy handling due to modular concept (“plug and play”)
- Records CO_2 plus influencing factors - more complete picture
- Near real time monitoring possible
- Very fast training of on-site staff possible (even via telephone)

How is UniRoma1 addressing these issues?

GasPro Network system

- Low-cost, in-house designed and built
- NDIR sensor behind gas permeable membrane for in situ soil gas CO_2 monitoring
- Potential for added sensors, like soil water content and pressure
- 2 high amperage “D” cell batteries last for about 5 months with measurement every hour. Can be easily changed in surface box.
- WiFi or radio communication with central station, other probes, or directly to the internet



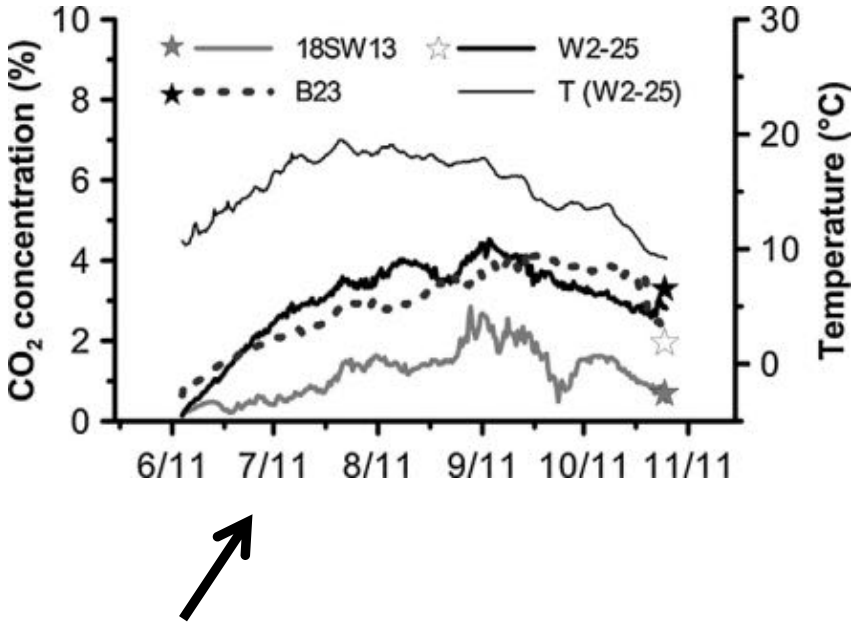
What has been achieved with the UniRoma1 system?

Deployments within ENOS

- 30-50 points will be monitored at the Sulcis Fault Lab (SFL)
- 1 point monitored for 6 months at Hontomin
- 3 points monitored at GTB, with BGS

Other deployments (some with previous version)

- CO2FieldLab (Norway injection test)
- Weyburn, Canada (CO2-EOR, near 3 wells)
- Latera natural leaking site (with OGS - ECCSEL)
- Voulund Denmark (baseline - SiteChar project)
- central UK (monitoring of fracking site, with BGS)
- Panarea natural leaking site (offshore, 20 points)

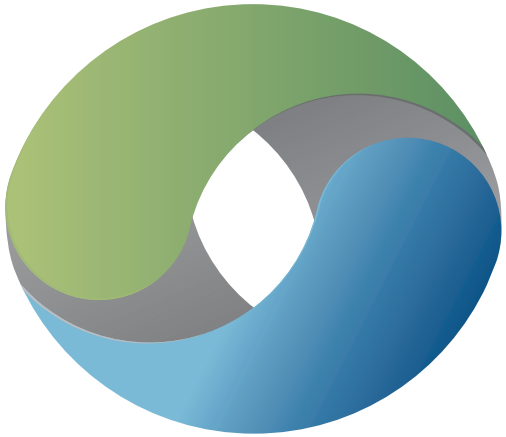


Beaubien et al., 2013, Int. J. Greenhouse Gas Control, v. 16, Supplement 1, p. S236-S262, DOI:10.1016/j.ijggc.2013.01.013.

What are the overall benefits of the UniRoma1 system?

- Easy to install, low maintenance, no moving parts
- Little surface expression, so less risk of vandalism
- True in situ measurement (sensor is underground). Easy removal for maintenance or re-calibration.
- Low cost allows for deployment of many units (e.g. 30-50 at SFL), thus improving spatial coverage.

- Low power consumption. No need for solar panels or mains connection.
- WiFi communications allows for direct connection to internet for near real-time data transfer
- Potential to create a WiFi network that can transfer data over longer distances via nodes



ENOS

Enabling Onshore CO_2 Storage

www.enos-project.eu

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