



Italy - Porto Tolle: storage in offshore saline aquifer

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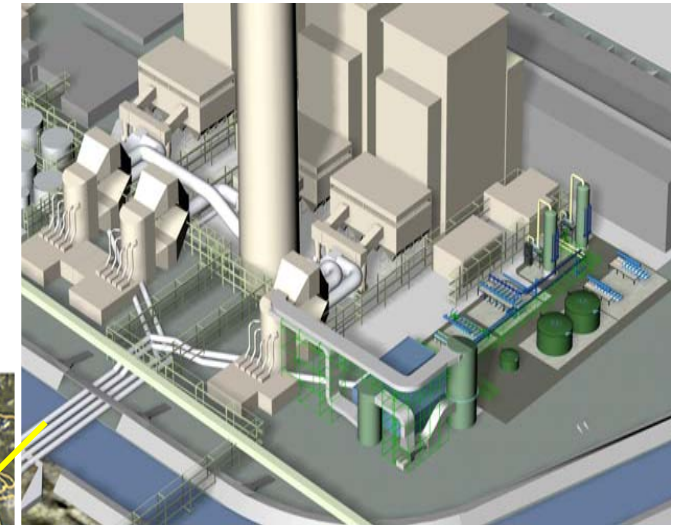
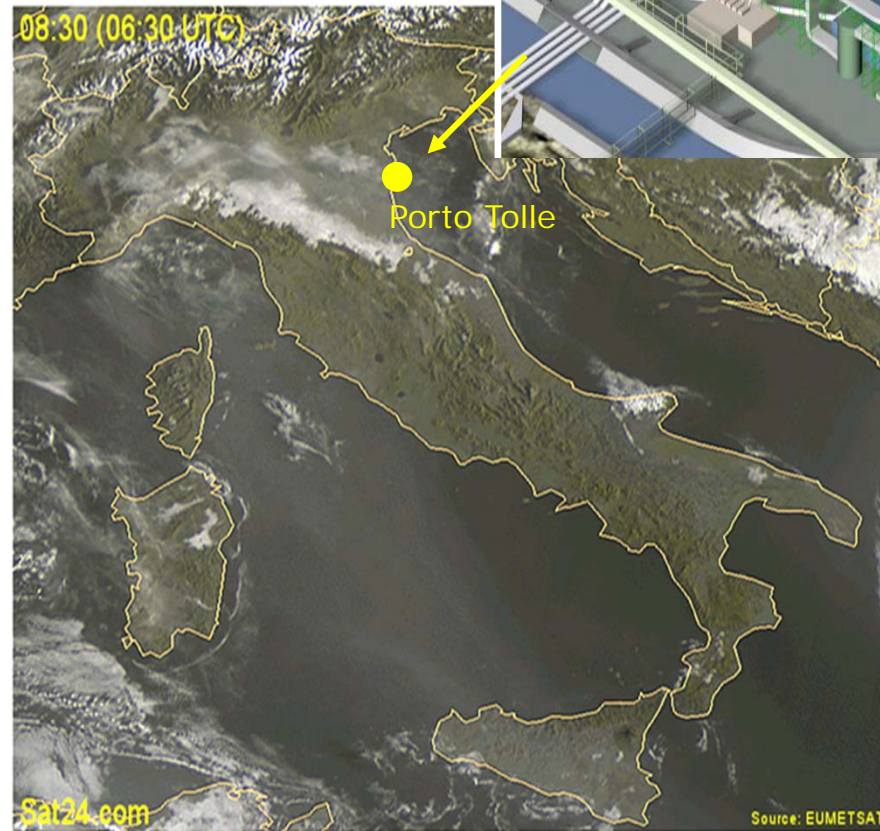
CO2GeoNet Open Forum

9-11 May 2011, San Servolo Island, Venice

High level overview of ZEPT project

Project goal

To retrofit one 660 MW_e coal fired unit, of Porto Tolle power station, with CO₂ post combustion capture equipment and start CO₂ underground storage in an off-shore saline aquifer by 2015 (injection rate 1Mt/y for 10 year)



Enel workflow strategy - 1

Capture

Lab scale

Research center - Brindisi



Flue gas 2 Nm³/h
CO₂ 0.4 kg/h

- Process evaluation
- Analytical protocols development

Pilot scale

Power plant - Brindisi

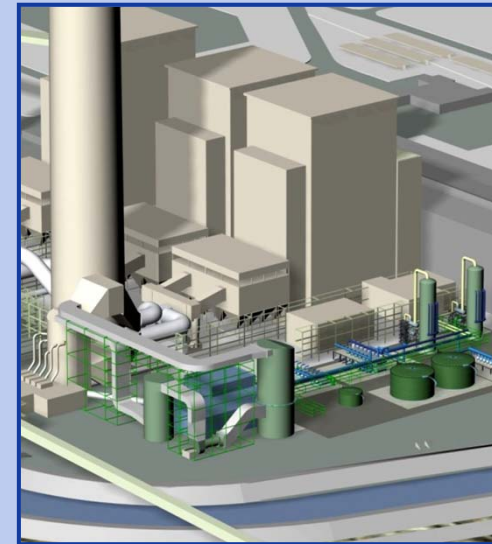


Flue gas 10'000 Nm³/h
CO₂ 2'500 kg/h

- Performance evaluation
- Emission analysis
- Tests on innovative process

Demo scale

Power plant – P.to Tolle



Flue gas 810'000 Nm³/h
CO₂ 180'000 kg/h

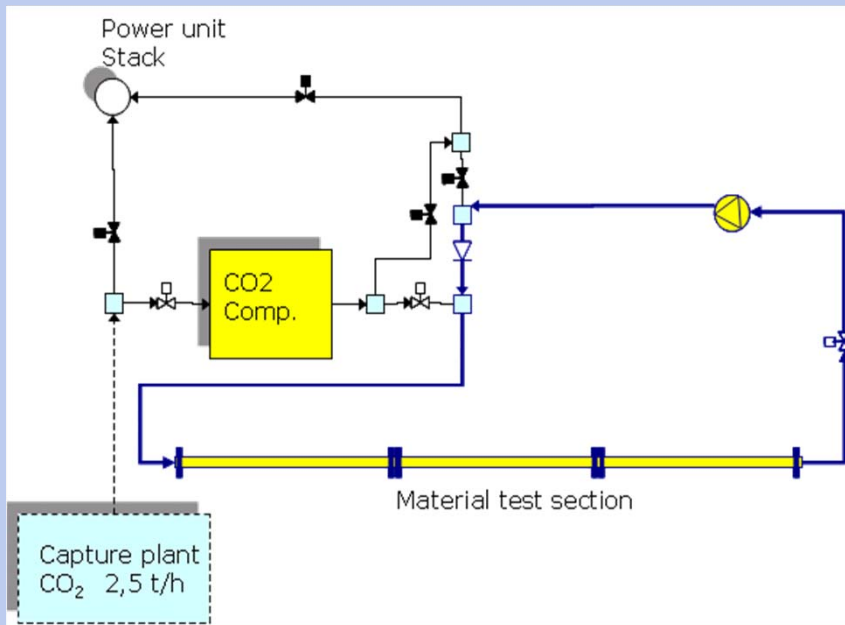
- Technology scale up

Enel workflow strategy - 2

Transport

Pilot scale

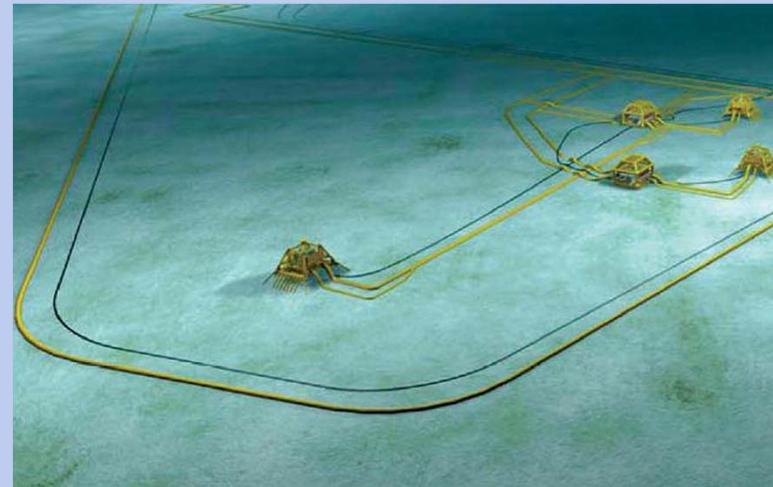
Power plant - Brindisi



- Validate design models (both stationary and dynamic) of the CO₂ transport line
- Optimize operating procedures
- Study corrosion problems related to the presence of impurities in the CO₂ stream

Demo scale

Power plant – P.to Tolle

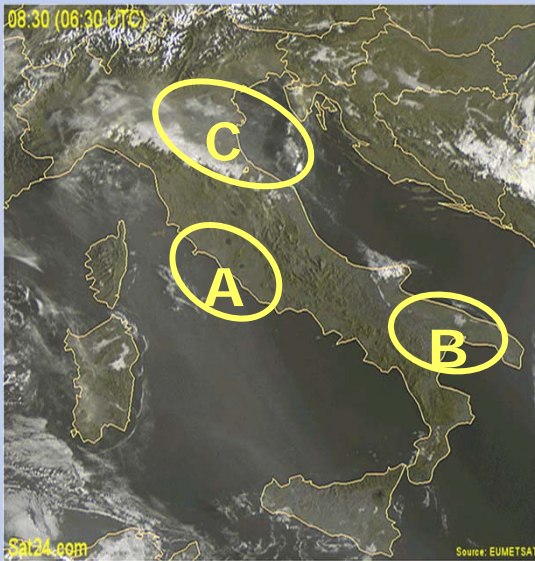


- Subsea pipeline ~ 100 km

Enel workflow strategy - 3 Storage

Basin scale

Italy

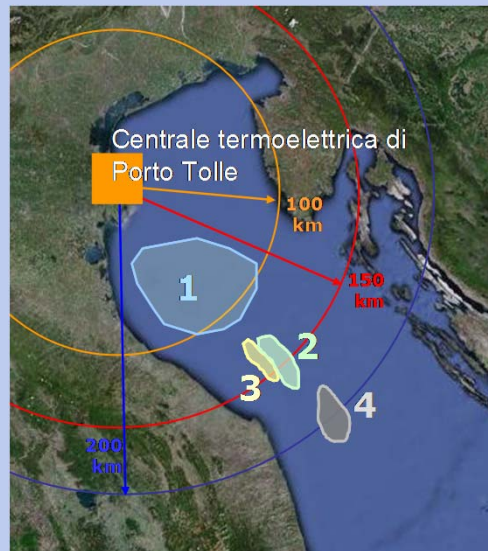


Estimation of the CO₂ geological storage potential in Italy, focusing on the areas next to main CO₂ source.

- Cesi Ricerca project
- GeoCapacity EU project

Regional scale

Northern Adriatic sea



The correlation between the borehole information and the available seismic lines led to the mapping of the reservoir and caprock depth.

- Public data

Local scale

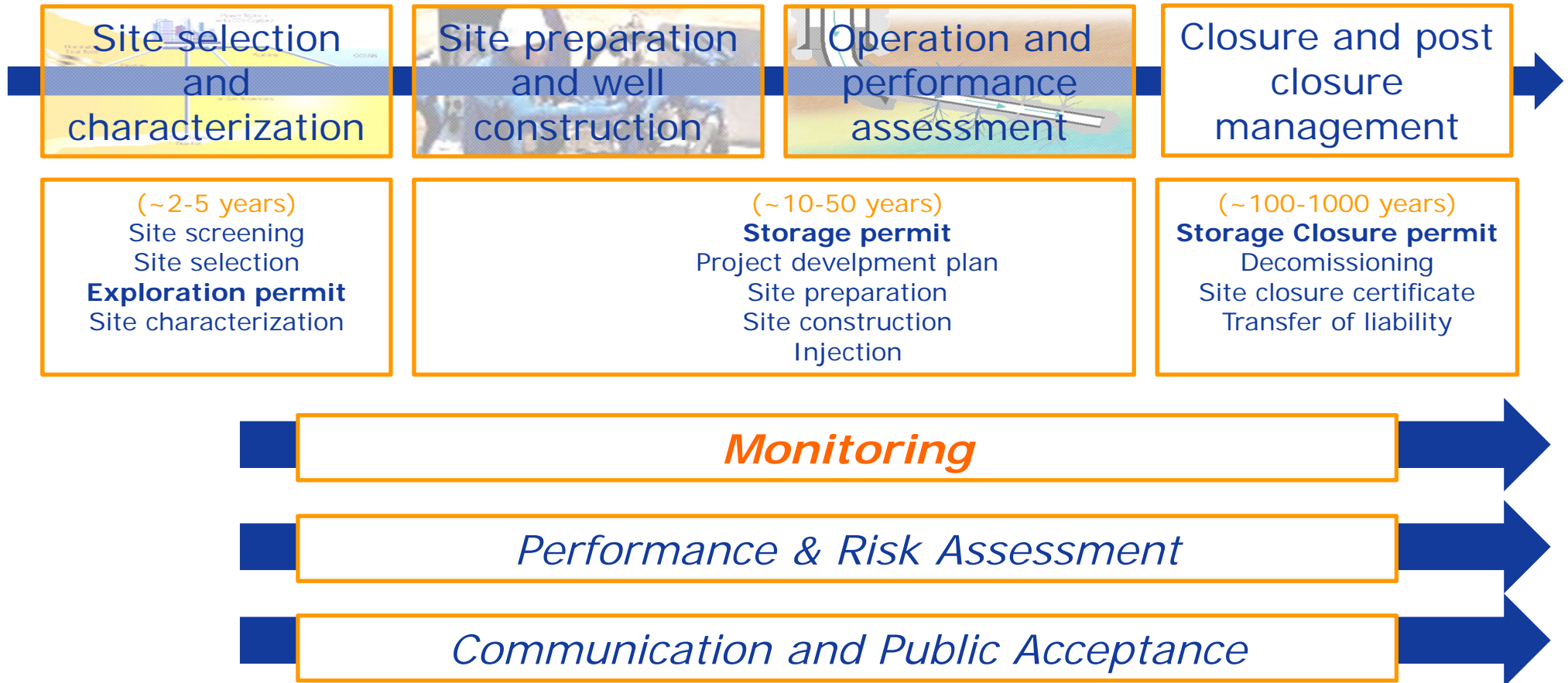
Storage structures



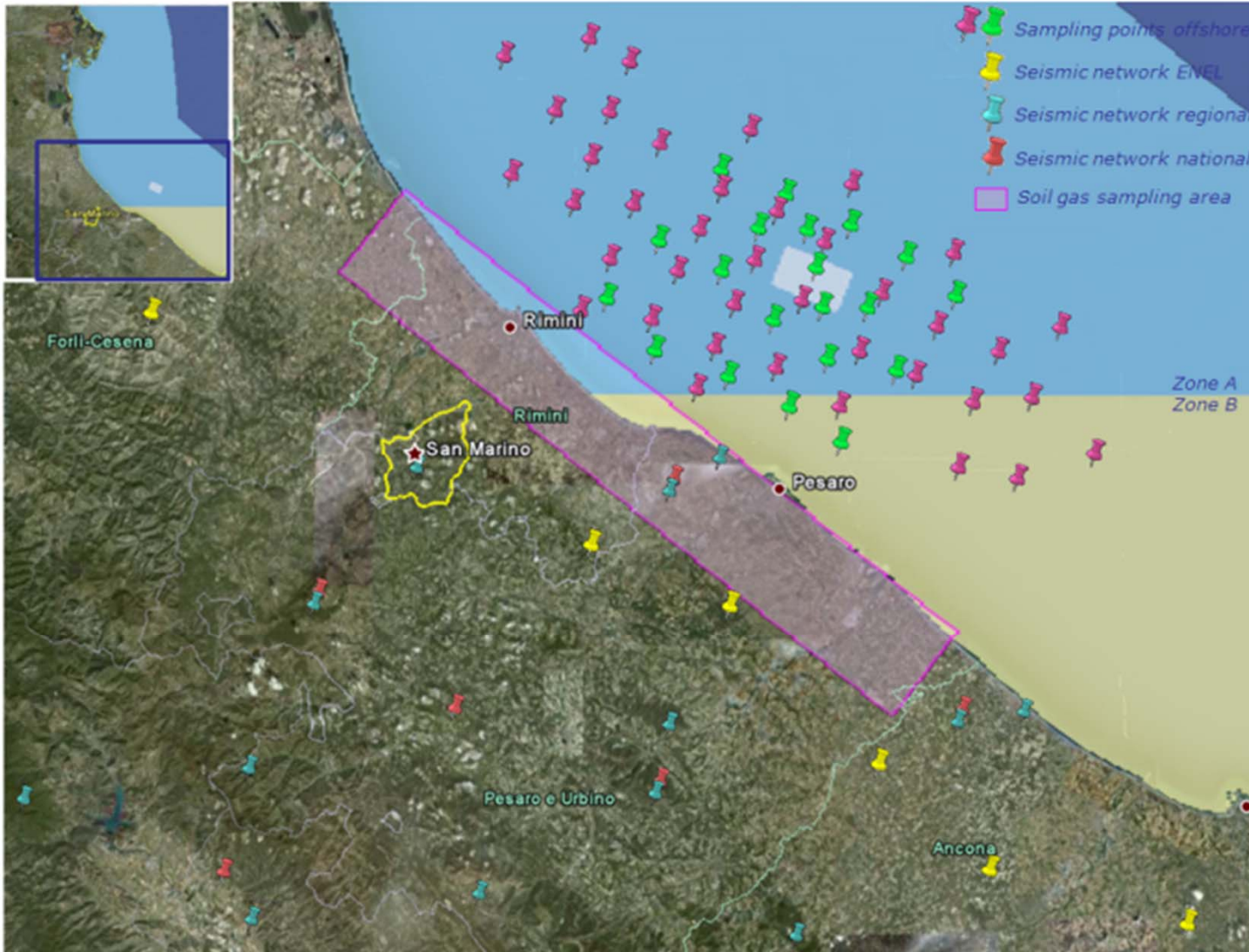
A characterization of the selected area was performed revealing that it is constituted by several structures. Static and dynamic modelling are ongoing

- Property data
- Field data

Overview of CCS project



Enel project Baseline surveys



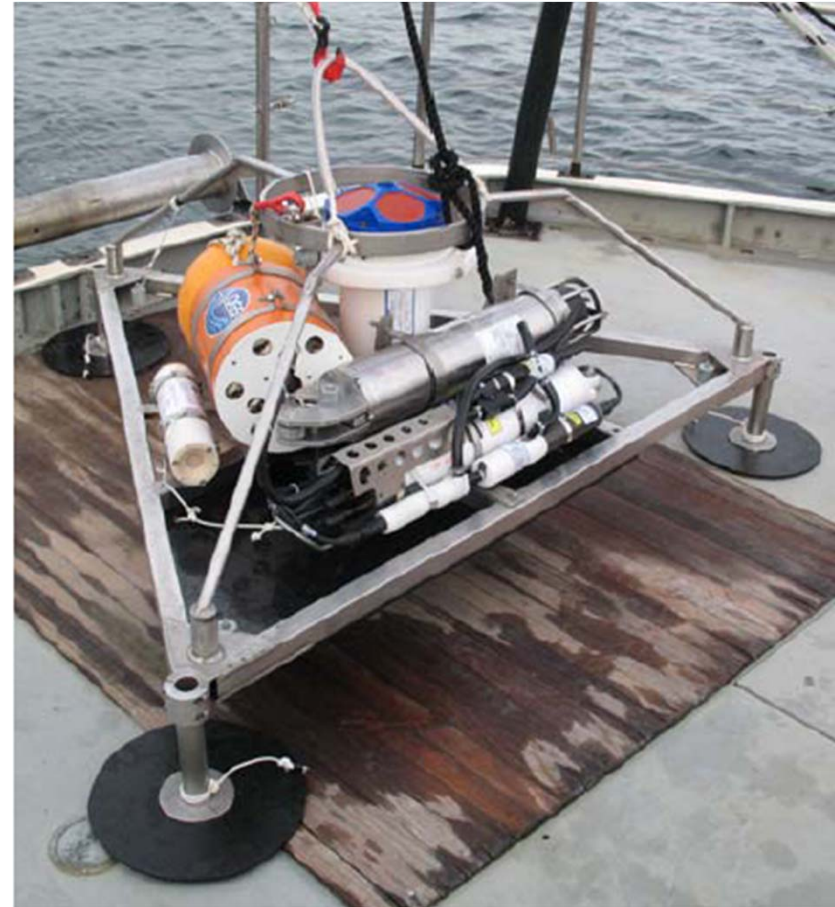
Based on request of European Directive on CO₂ geological storage it was planned to evaluate CO₂ baseline before injection.

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Pre-injection off-shore survey

The baseline study covers a $\sim 400 \text{ km}^2$ area around the more probable injection locations in water depths ranging from 13 to 40 m.

Measurements include chemical, biological and physical analyses of both the water column and the near-surface sediments during four different periods of the year to define the ranges of baseline values in the area, both spatially and temporally.

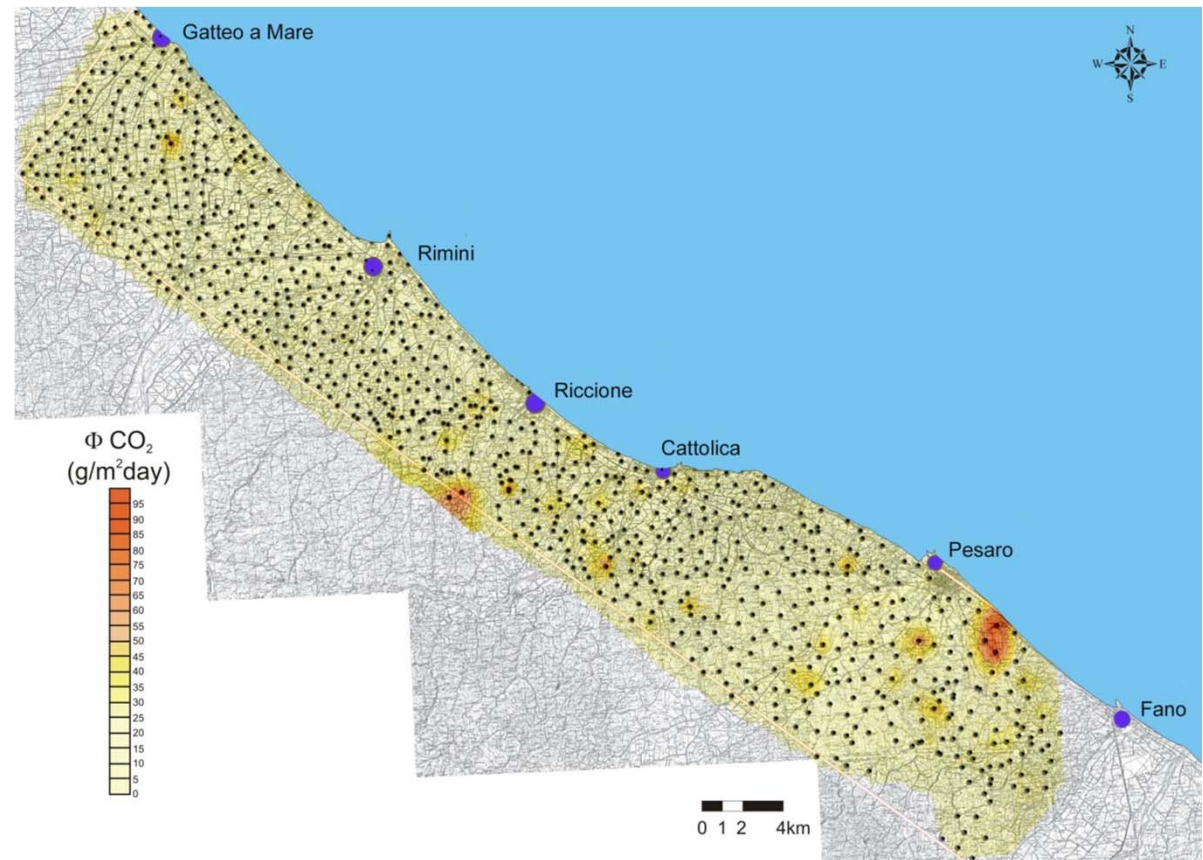


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Pre-injection on-shore survey

The development of the pre-injection grid was carried out through

- ✓ soil geo-gas measurements (CO₂ and CH₄ fluxes)
- ✓ geo-gas concentrations (CO₂, CH₄, He, ²²²Rn, H₂S, CO, H₂, N₂, O₂, and light hydrocarbons)
- ✓ shallow and deep aquifer fluids in terms of physico-chemical parameters (temperature, salinity, pH, redox conditions), chemical composition (major, minor and trace elements) and dissolved gases content.



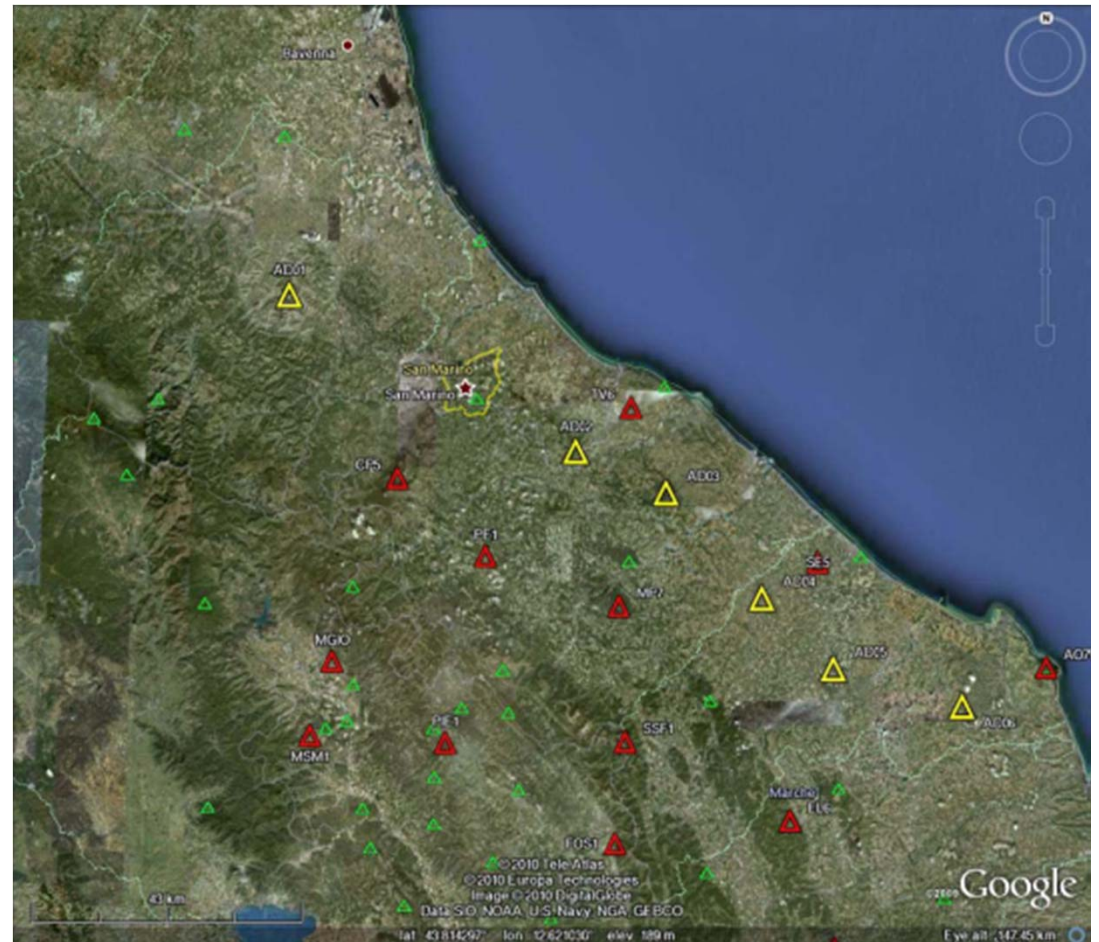
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Evaluation of pre-injection micro-seismicity

Study of historical seismicity of interesting areas.

The goal of the feasibility studies is the collection of a **new passive seismic dataset**, in order to increase both the seismic behavior and the deep geological and tectonic setting of the area.

The aim of the seismic experiment is to increase the grid of the permanent seismic networks already available (Italian National Seismic Network and Marche Seismic Network) in order to increase the sensitivity of the networks and locate earthquake with $ML < 2$.

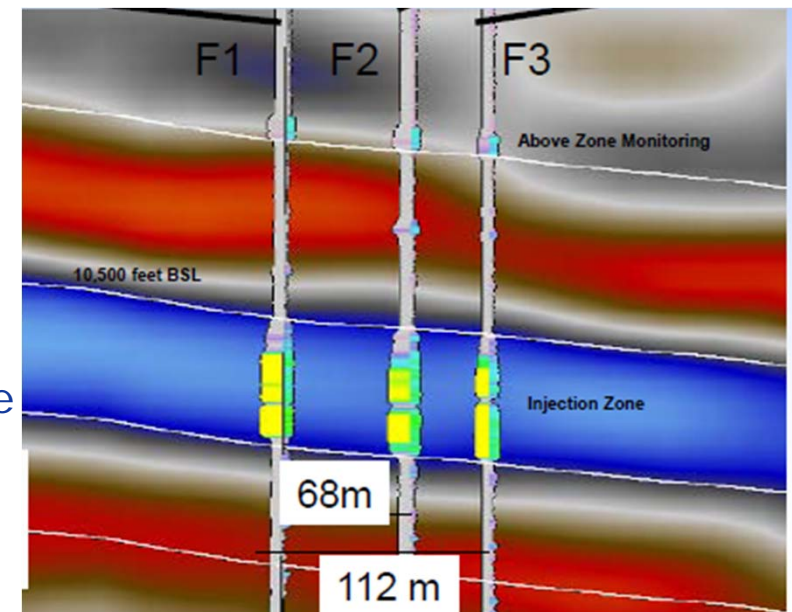


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Design of an seismic monitoring plan

It consists of a chain of actions involving:

- ✓ Building a model of the physical properties in the rock formations from the surface to the aquifer/reservoir;
- ✓ evaluation of the change in seismic properties varying CO₂ saturation;
- ✓ calculation of synthetic seismograms and topographic modelling;
- ✓ evaluation of delectability of the injected CO₂, both in the hosting formation (CO₂ plume) and in the overlying formations (possible leakages);
- ✓ plan of the most effective seismic acquisition pattern in terms of cost/benefits and lower impact on the investigated areas (planning optimization).



Open questions

- ✓ Adaptation to site-specific constraints
- ✓ Definition of area of interest
- ✓ Guidelines on monitoring tools selection
- ✓ Minimum requirements in monitoring plan definition

Thank you for your kind attention

