British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

SEVENTH FRAMEWORK PROGRAMME

Assessing ecosystem impacts of CO_2: the RISCS project (**R**esearch into **I**mpacts and **S**afety in **C**O_2 **S**torage)

Ameena Camps, IEA-GHG

For RISCS project team

SEVENTH FRAMEWORK PROGRAMME

Background and aims

- Significant leakage from CO_2 storage is not expected
- If it did occur there could be adverse effects on the environment
- These effects are not well constrained

RISCS aims to carry out research on impacts arising from known CO_2 fluxes (observed and modelled)

- In both marine and terrestrial environments
- Through experiments and natural field observations

- To fullfill developing regulatory requirements
- Meet needs of full scale, full chain demonstration and large scale deployment of CCS

Project overview

RISCS will provide information to underpin

- Evaluation of safety of storage sites
- Environmental Impact Assessments
- Safe design of sites to minimise impacts
- Design of near surface monitoring strategies
- Refining of storage licence applications/conditions
- Frameworks to communicate safety of storage

Ultimate product is ‘Guide for Impact Appraisal’

Project overview

- 4 year project, fully funded (€5.3M), started January 2010
- 24 participants (UK, Greece, Netherlands, Italy, Norway, Sweden, France, Germany) + Australia, Canada, USA
- 6 industrial participants (Enel, Statoil, Vattenfall, EoN, PPC, RWE) providing funding (c €200k each), research input and advice
- 4 non-European participants (CO_2CRC & Montana State, Regina, Stanford universities) in advisory role
- 1 NGO (ZERO)
- CO_2GeoNet (Primarily represented by NIVA, BRGM in addition to 5 participants)
- IEA-GHG – advice and help with dissemination

Project organisation

- WP1 Description of reference environments and scenarios
- WP2 Assessing impacts in marine environments
  - Experiments and field observations
- WP3 Assessing impacts in terrestrial environments
  - Experiments and field observations
- WP4 Assessing impacts - numerical simulations
- WP5 Integration and dissemination
- WP6 Coordination/management

WP1 Description of reference environments and scenarios

- WP1 will develop a credible set of CO_2 impact scenarios for varied near-surface reference environments through workshops and follow up studies
- The scenario analysis process will explore:
  - Main Features, Events and Processes (FEPs) of CCS systems
  - How such systems are likely to evolve with time
  - Potential failure/leakage mechanisms
  - Potential human/ecological impact mechanisms
- The scenarios will be a basis for experiments, field studies and models investigating impacts and for communication
- The overall purpose of the scenarios is to provide a sound basis for the regulation and monitoring of CO_2 storage sites.

WP2 Assessing impacts in marine environments via field experiments and observations

Panarea field site, Italy

OGS/PML: <10 L?

PML: 1000 L

IMARES : 4500 L

+ benthic chamber lander

WP2

- 2.1 Experiments in artificial enclosures
  - Response & recovery individual species (growth, survival, reproduction)
  - Response & recovery benthic communities
    - Microbial, macrofauna, meiofauna
    - Speed and scale of impacts
    - Rate of lateral recolonisation
    - Speed of larval recruitment
  - Benthic Chamber (Norway)
    - 3 exposure experiments at different exposure rates in 400m water for 10 days
- 2.2 Field observations
  - Chemical, biological and physical monitoring at Panarea site, southern Italy

WP2 Field observations

- To address system complexity and **spatial-temporal variability** at a marine site where natural CO_2 is leaking to the water column through vents and diffuse leaks at different rates
- To extrapolate the laboratory and mesocosm experiments into **real-world** situations
- An integrated study including measurements of the physical, chemical, and biological systems

WP3. Assessing impacts in terrestrial environments via field experiments and observations

Northern Europe

- Norwegian experiments
- UK (ASGARD) experiments

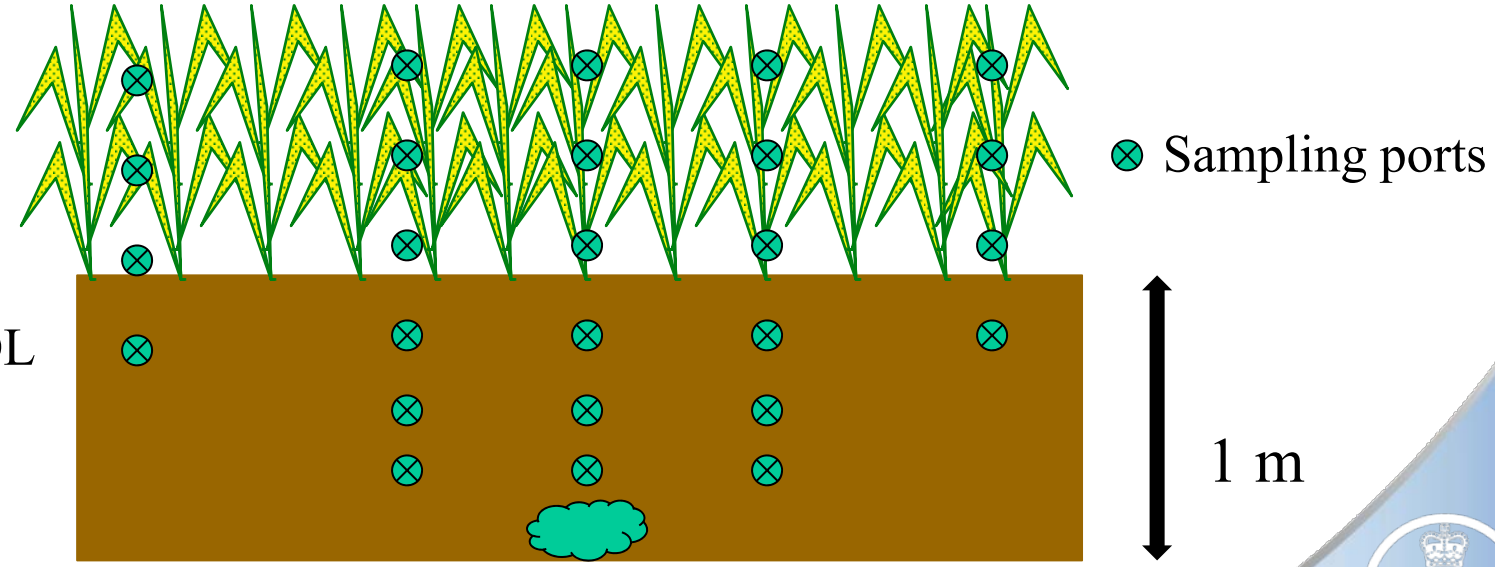
Southern Europe

- Observations (Italy, Greece, France)

Norway

- Effects (greenhouse experiments)

- Exposure (simulated CO_2 leak)



UK: ASGARD

- Inject controlled amounts of CO_2 into soil
- Test detection techniques
  1. Remote sensing
  2. Isotope analysis
  3. Continuous monitoring
- Monitor changes in plant and soil conditions (chemistry, microbiology)
- Test sensitivity to soil and plant types and gas concentration (impact thresholds, effects on roots, ecosystem recovery)

WP3.3: Naturally leaking sites in southern Europe

- Florina well site, Latera, San Vittorino and Montmiral sites
- Wide variety of flux rates, time scales and gas compositions
- Impact of leaking gas on:
  - Vegetation
  - Potable groundwater quality

- Impact of using CO_2-impacted groundwater for crop irrigation

WP4 Assessing Impacts – numerical solutions

- **Synthesise** information from WPs 1, 2 & 3
- Quantify CO_2 **transport** onshore and offshore in space/time and the associated chemical **perturbation**
- Develop:
  - **Marine model system** describing the key biogeochemical and ecological components relevant to CO_2 and its impacts in shallow sediment layer and overlying water column (varying depth, mixing, temperatures and fauna)
  - **Terrestrial systems model** representing the important processes in the transport of CO_2 to and in the near-surface terrestrial environment, and its impacts (e.g. pH evolution and groundwater quality)
- For reference environments and scenarios from WP1

Guide for Impact Appraisal

An integration of main results to inform key stakeholder groups on specific issues:

- What to consider when appraising potential impacts in the event of leakage from a storage site
- How to evaluate the potential impacts of storage project development: design stage, construction, operation, post-injection and to enable transfer of site liability to the competent authority
- Options for directly assessing the potential scales (temporal and areal, realistic leakage ranges (fluxes, masses)) and ecosystem responses;
- Options for identifying, predicting and verifying the nature of impacts

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