



The University of
Nottingham



A facility for investigating environmental impacts of CO₂ leaking from storage facilities

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ASGARD (Artificial soil gassing and response detection) –background

- An understanding is required of the risk of leakage from carbon capture storage sites or from the infrastructure used to transport the CO₂
- Detection of leaks and knowledge of the effect of leaking CO₂ on surface ecosystems is important.
- Our approach is to inject controlled amounts of CO₂ into soil
 - Test detection techniques using remote sensing or isotope analysis
 - Monitor changes in plant and soil conditions
 - Test sensitivity to soil and plant types and gassing rate

ASGARD –development of experimental site

- The site was set up at the University of Nottingham’s Sutton Bonington campus
- 34 plots each 2.5 x 2.5 m were marked out and prepared with 3 crops.
 - 8 were left as pasture
 - 8 plots were planted with barley
 - 8 plots were planted with linseed
 - 6 plots were left for additional experiments
 - 4 plots were marked out at a distance from the main site to act as remote controls



ASGARD –development of experimental site

- CO₂ gas was delivered at a depth of 60 cm to 4 plots in each crop from 200 l cryotanks via MDPE pipes
- Gas delivery was controlled with solenoid operated mass flow controllers
- Gas was delivered at a rate of 3 l hr⁻¹ between 16th May and 26th September 2006

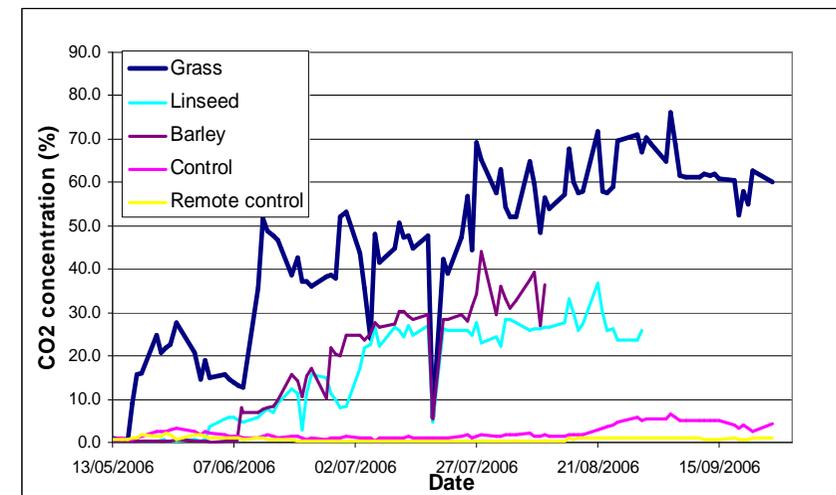
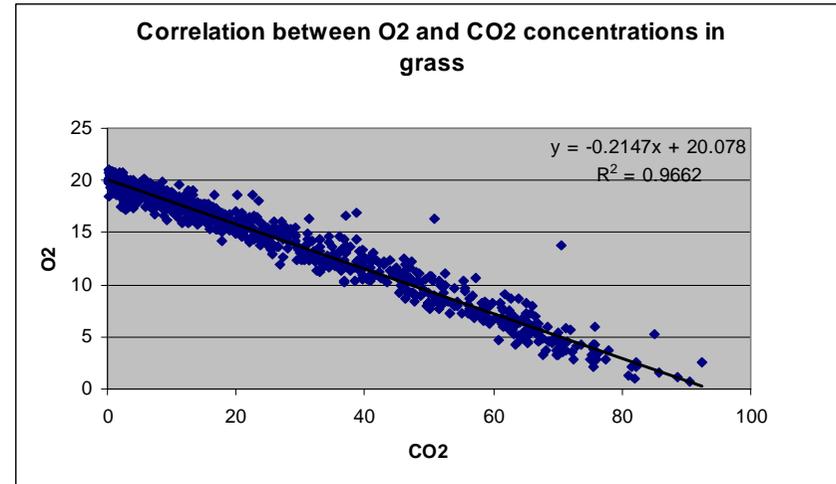
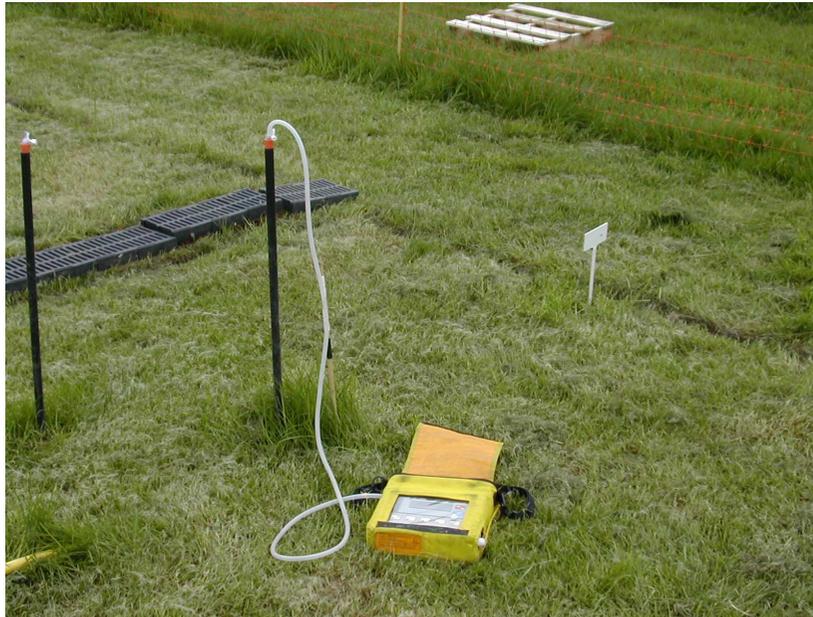


FLOW CONTROL (TVC Ltd Tel:01493 443800, www.TVCALX.co.uk) REVISION: 7.0

ON	Crop	Flow S/Pl	Mass Flow	Deg	Psi	Gas	Litres24h	LitresUsed	Fault
1	L4	3.0	2.996	25.5	14.84	CO2	4990	35855	0 OK
2	L1	3.0	3.001	24.9	14.89	CO2	4990	35856	0 OK
3	L3	3.0	3.004	26.3	14.88	CO2	4990	35847	0 OK
4	L2	3.0	2.998	25.1	14.88	CO2	4990	35846	0 OK
5	B4	3.0	2.995	25.0	14.96	CO2	4989	35853	0 OK
6	B1	0.0	0	22.3	23.29	CO2	0	39	0 OK
7	B7	3.0	3	24.3	14.88	CO2	4989	35848	0 OK
8	B6	3.0	2.999	22.9	14.87	CO2	4988	35847	0 OK
INLET		22.2	18.1	24.44	CO2	36911	267735	0 OK	OK
PAGE		CONTINUOUS LEAK DETECTION L.P.M		CO2 DETECTOR					
SETUP		0 < 20.99 < 30		OK					
HISTORY		ALARM CANCEL		99.7%		NO MESSAGES		EXIT	
		TankCapacity		GSMStatus: 0 Finished Text					

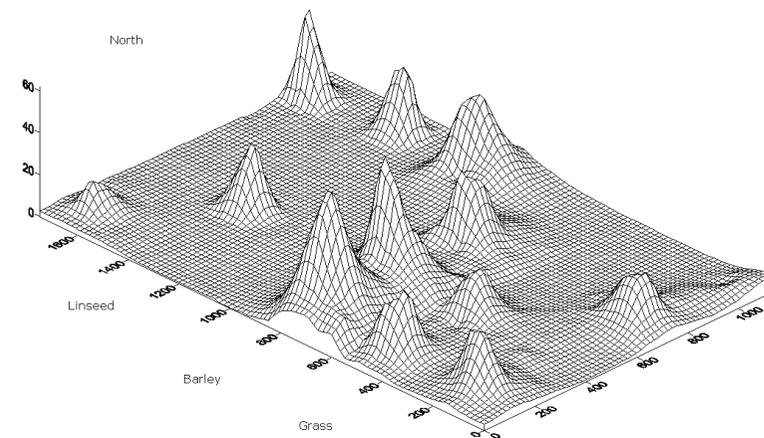
Gas concentration

Soil gas concentration was measured on a daily basis using permanently installed sampling tubes.



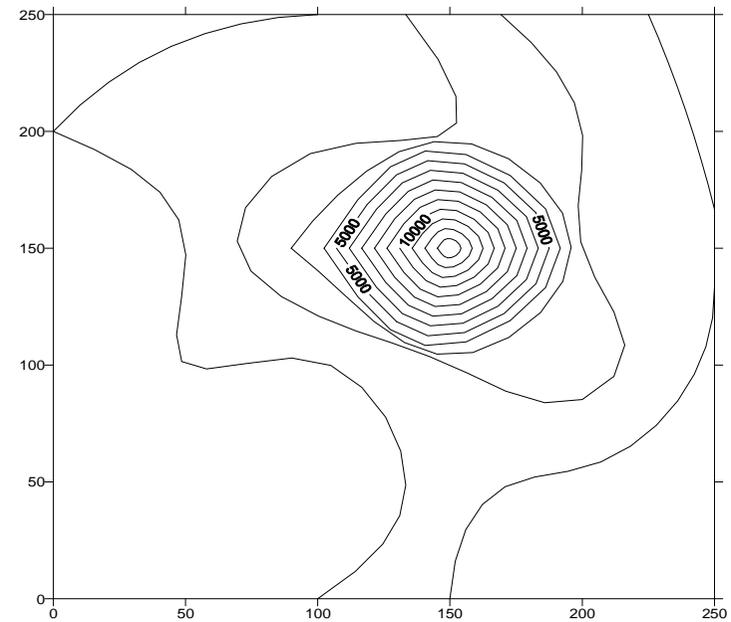
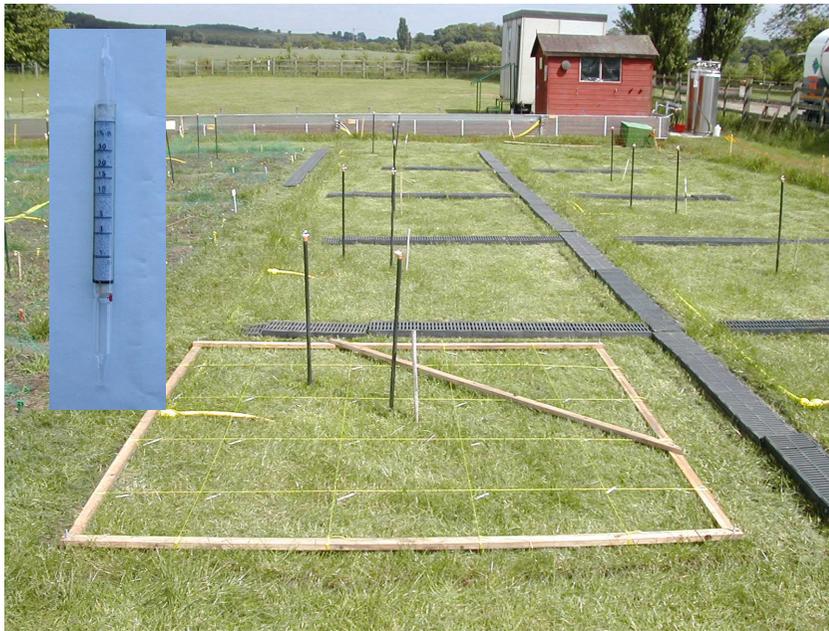
Gas distribution within plots

Barholes, 30 cm deep, were made at 50 cm intervals over the plot. CO₂ measurements were taken using the GA2000 gas detector



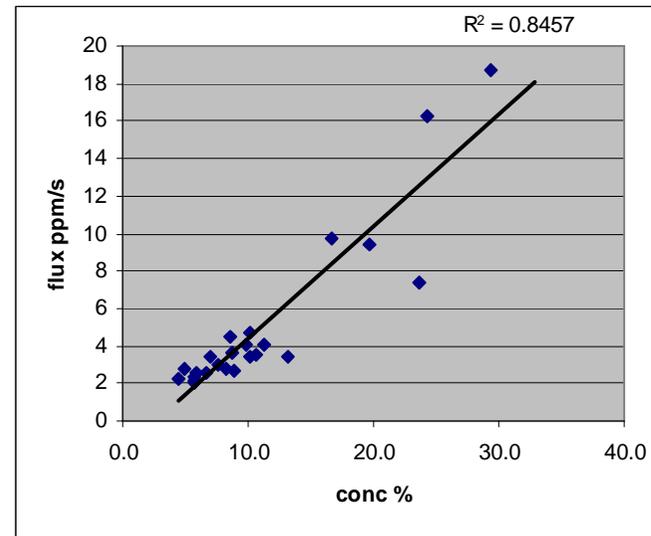
Surface CO₂ measurements

Draegar tubes were used to measure CO₂ at the surface



CO₂ flux measurements

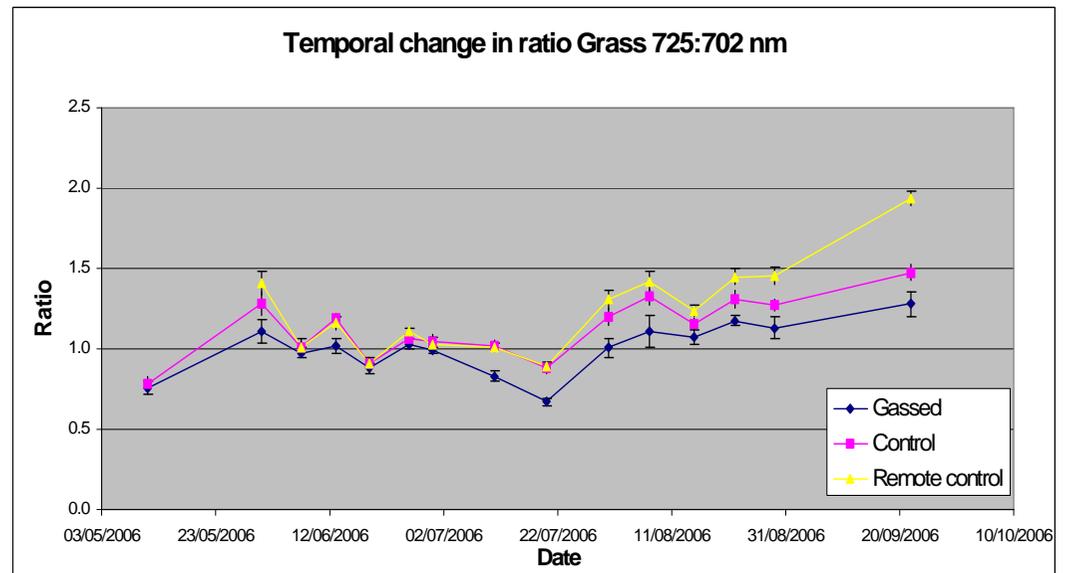
CO₂ flux was measured by BGS using a West systems fluxmeter



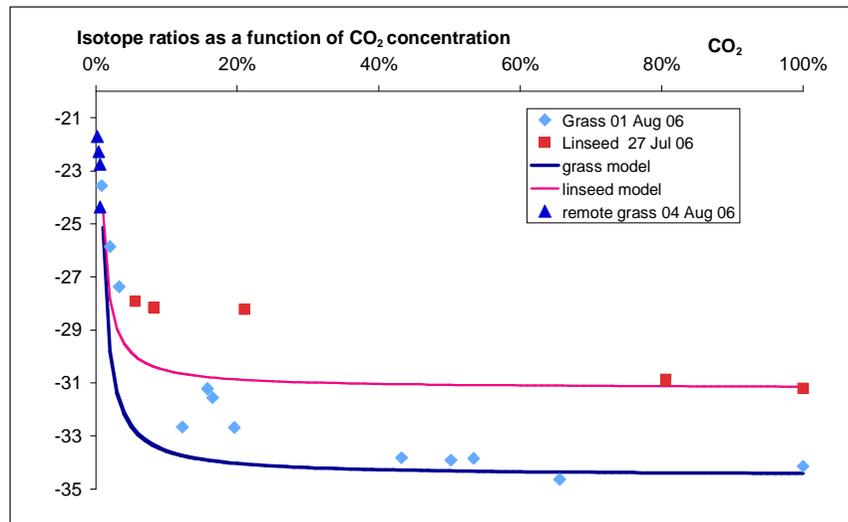
Correlation of CO₂ flux with soil CO₂ concentration

Vegetation stress

Spectral measurements were taken at 50 cm intervals along a transect in each plot.



Isotope measurements



Conclusions

We have successfully developed the ASGARD facility and demonstrated:

- Controlled release of CO₂ into the soil
- Demonstration of CO₂ movement within, and flux out of the plots
- Detection of plant stress effects through spectral monitoring and the ability to identify leaking CO₂ at low soil concentrations
- Successful use of isotopes in discriminating between geological and biogenic carbon for identification of leaking CO₂
- We believe that characterisation of leaking CO₂ hazards in the environment and validation of detection techniques will help to provide the basis for public confidence in CCS.

Acknowledgments



ASGARD

Artificial Soil Gassing And Response Detection

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We thank British Geological Survey for characterisation of the site and assistance with flux measurements.

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