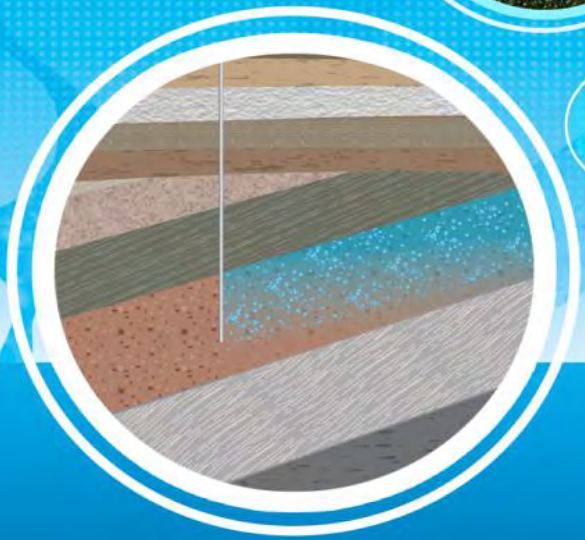
The Ginninderra greenhouse gas controlled release facility

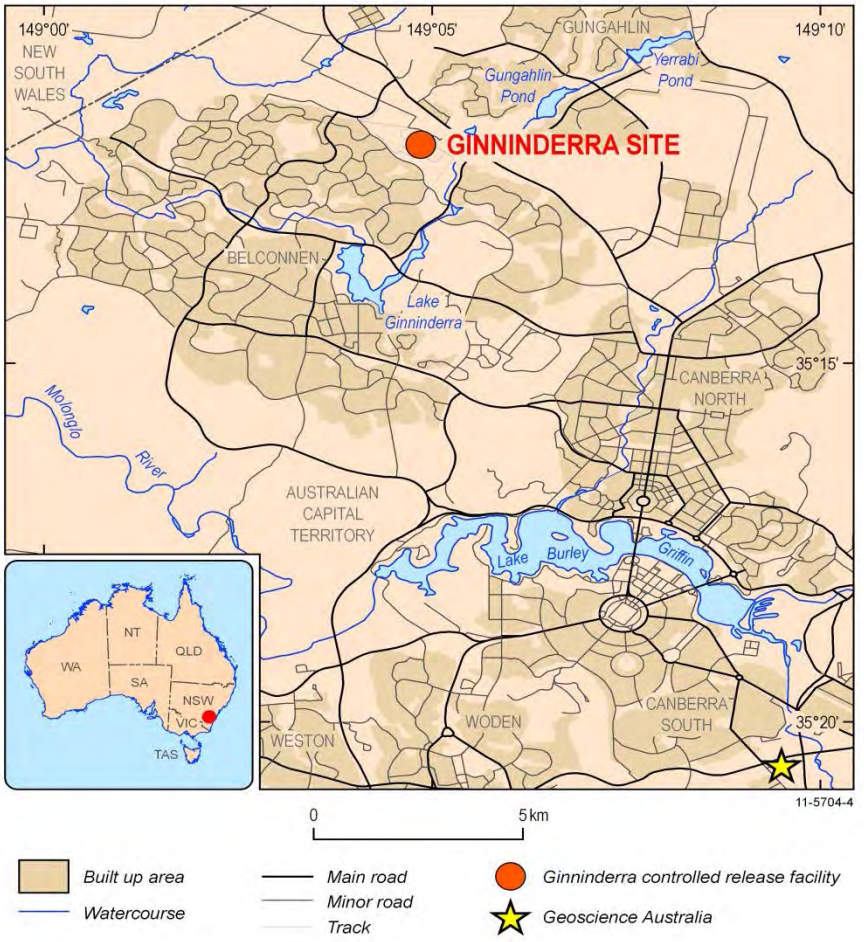


Andrew Feitz
Section Leader
Geoscience Australia
CO2CRC

Carbon Sequestration Leadership Forum
Monitoring Workshop
18 April 2013

GA-CO2CRC controlled release facility

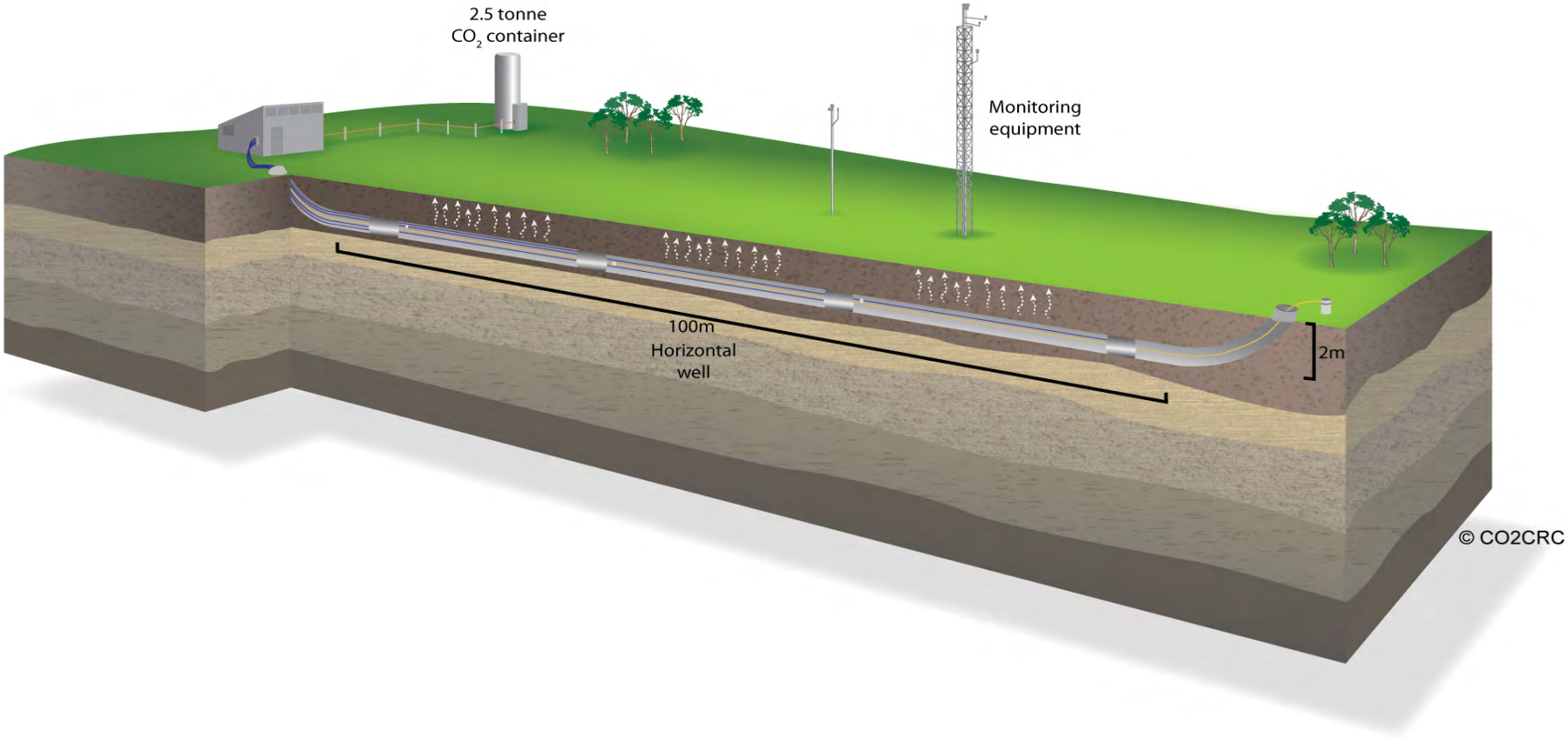
- **Collaboration between Geoscience Australia and the CO2CRC**
- **Hosted at CSIRO Ginninderra Experiment Station**
- **800 hectares of cropping/grazing land**
- **10km from centre of Canberra**
- **All year access**




World • Australia • ACT • Canberra
N
1000 feet
250 m
© 2012 Microsoft Corporation. Image courtesy of 3Di Boulder

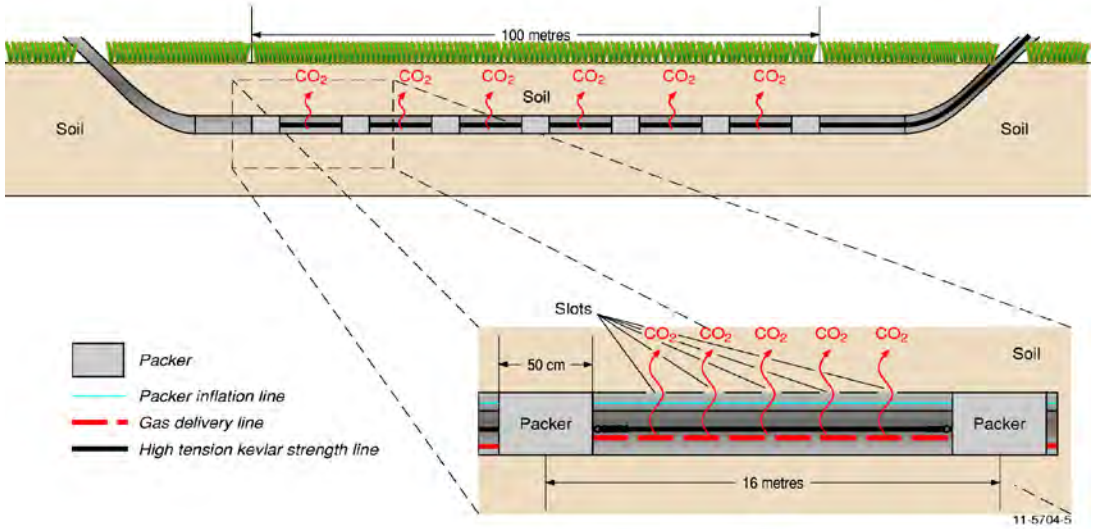

N
CO_2 tank
Location of horizontal well
Groundwater monitoring wells (baseline)
20 m
© 2012 Microsoft Corporation - Image courtesy of 3Di Boulder

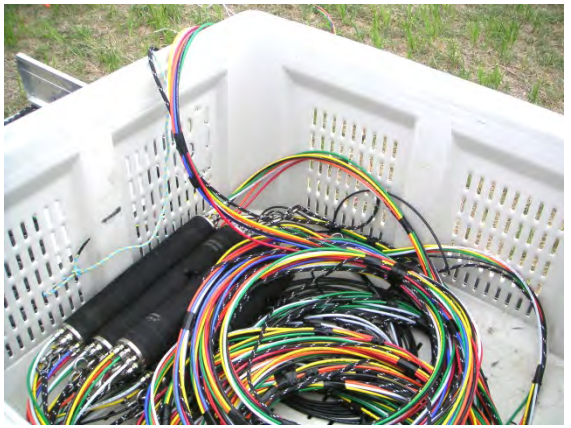
GA-CO2CRC Greenhouse gas controlled release facility, Ginninderra, ACT



Horizontal well and packers

- **Based on ZERT facility**
- **125mm ϕ HDPE pipe x 120m long**
- **Slotted every 0.5m over 100m, installed 2m deep**
- **Six release chambers**
- **Sandy loams and clays with occasional coarse gravel**





CO_2 supply

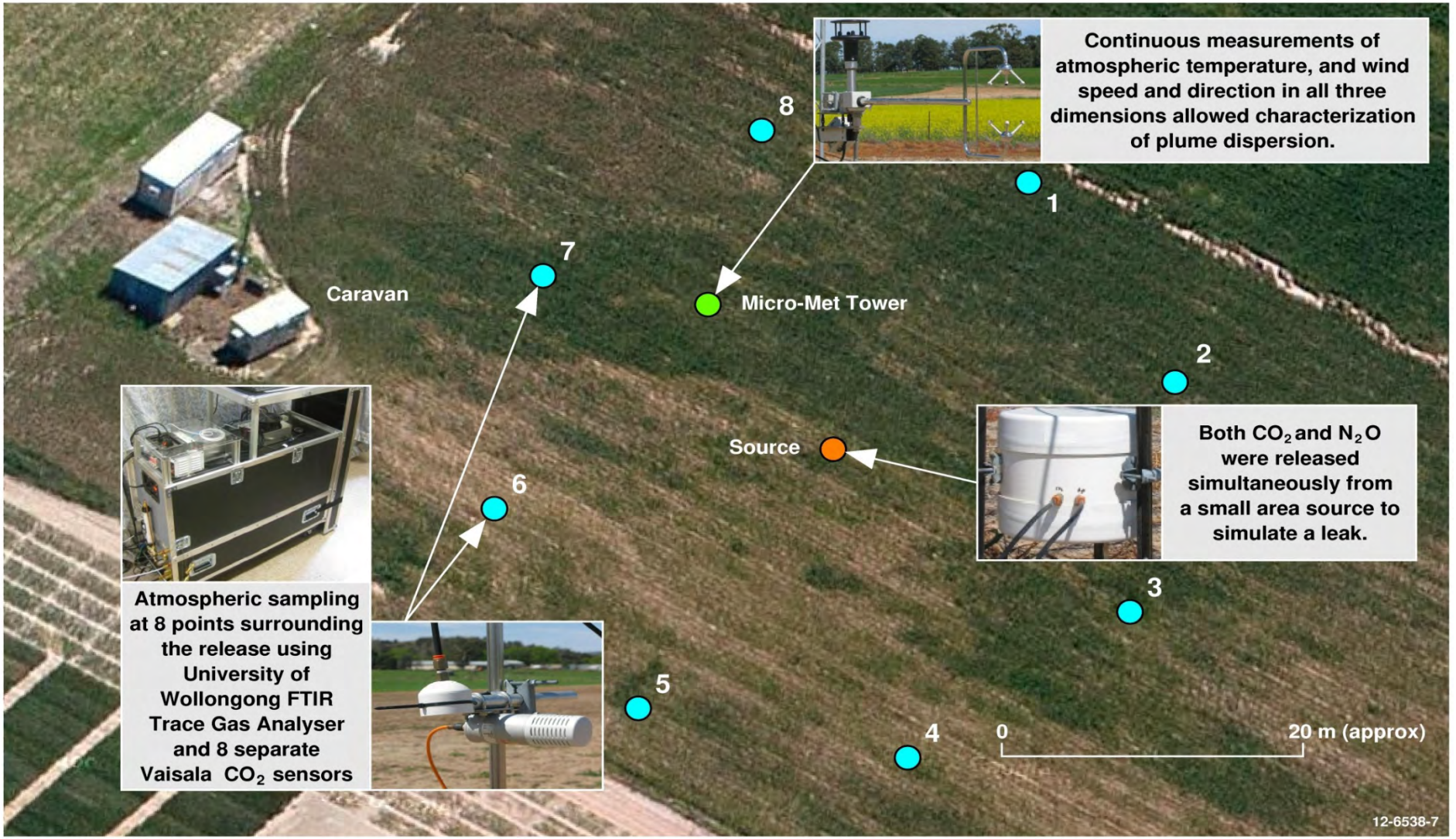
- 2.5t liquid CO_2 tank
- Maximum CO_2 capacity is 600 kg/d
- First sub-surface release – 100kg/d (over 5 chambers)
- $\delta^{13}C$ of CO_2 ~ -18‰

  (source is primarily from an ethanol plant)

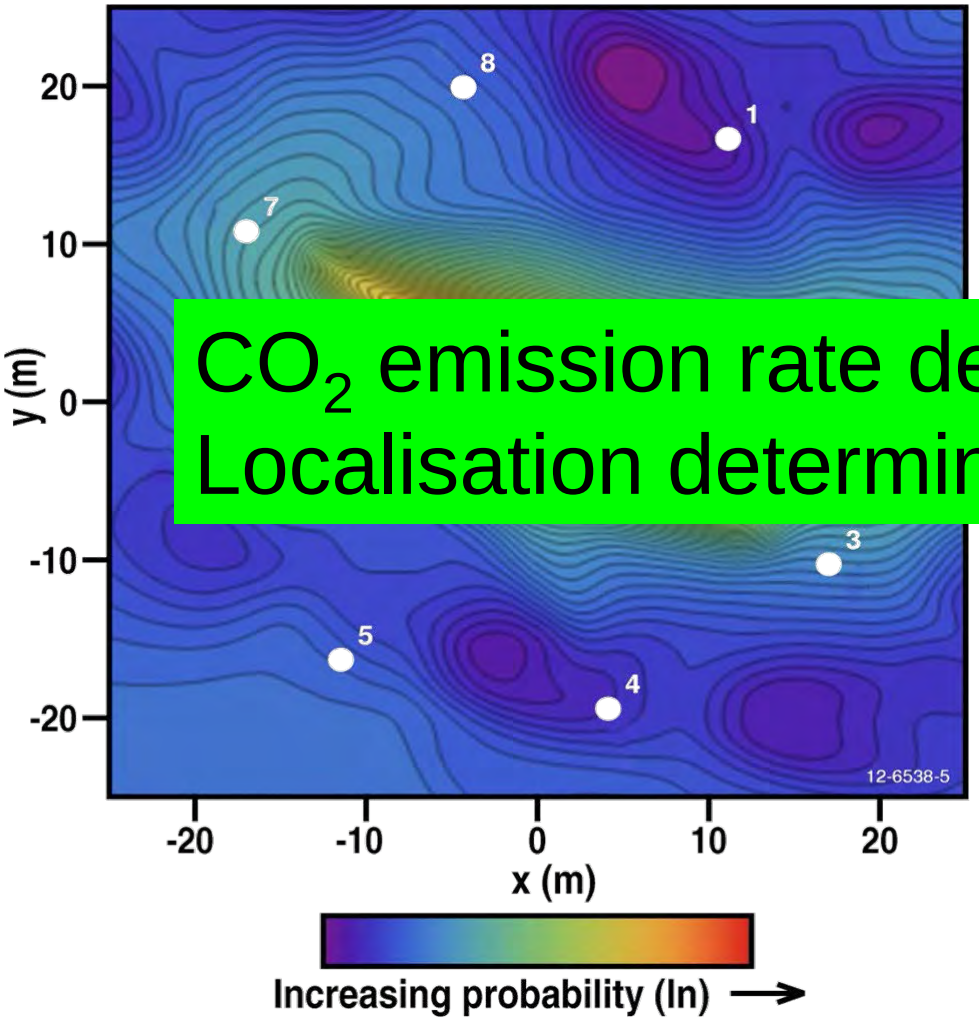
Pre-release: above ground experiment (2010)

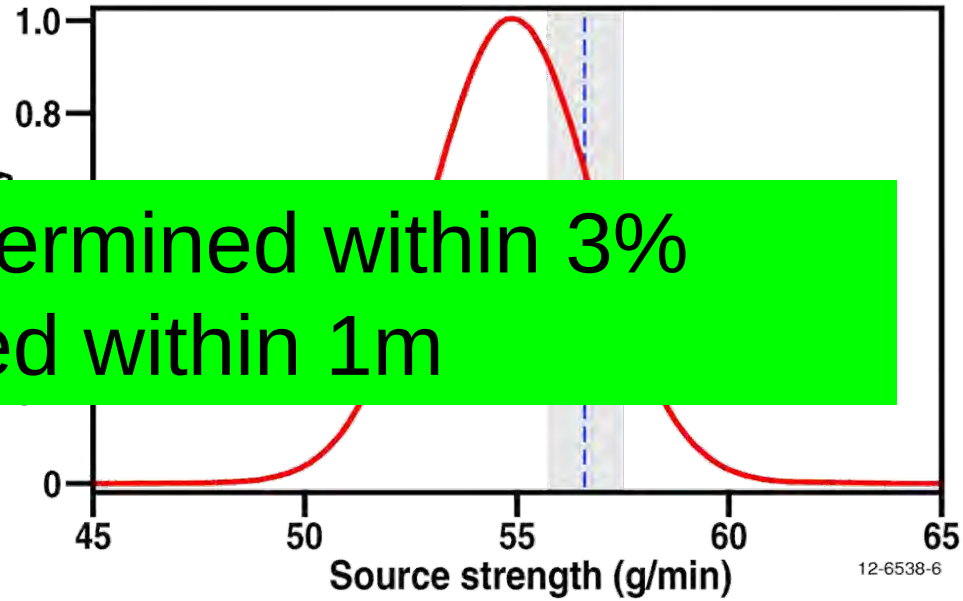
60 kg CO_2/d

Atmospheric tomography (Bayesian inversion)



Simultaneous localisation and quantification

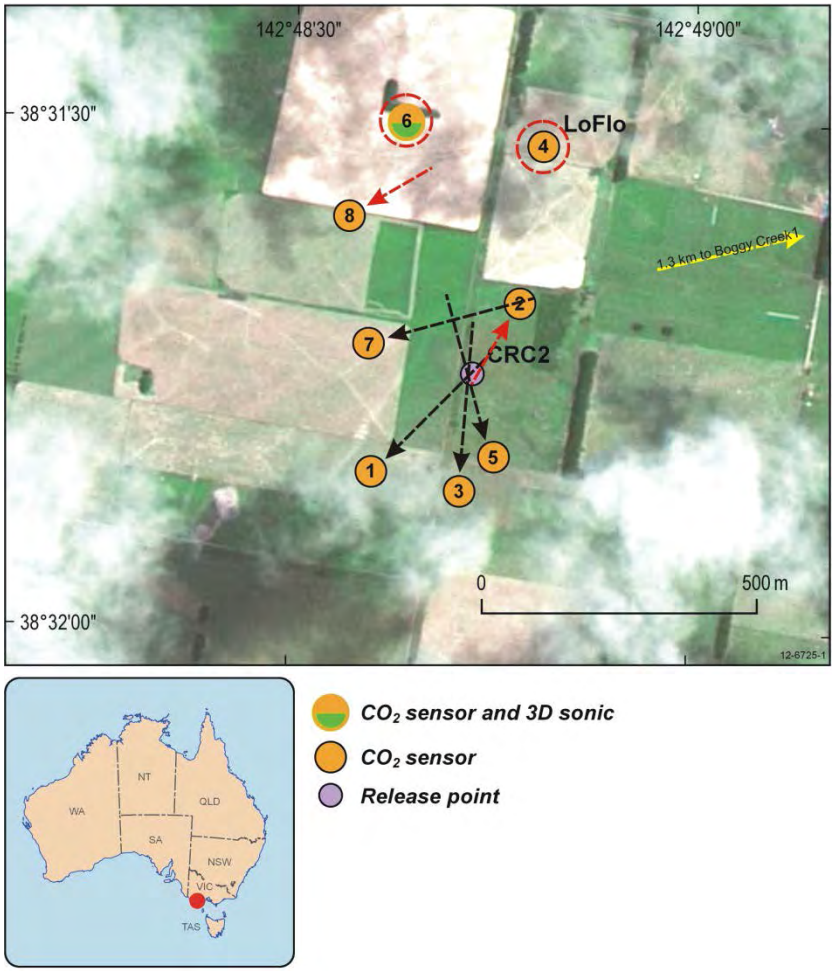




CO_2 emission rate determined within 3%
Localisation determined within 1m

Scaling up: Atmospheric CO_2 sensor array (CO2CRC Otway Stage 2B)

- **9 - 15 t/d controlled CO_2 releases**
- **Sensors 150 - 470m from release pt**



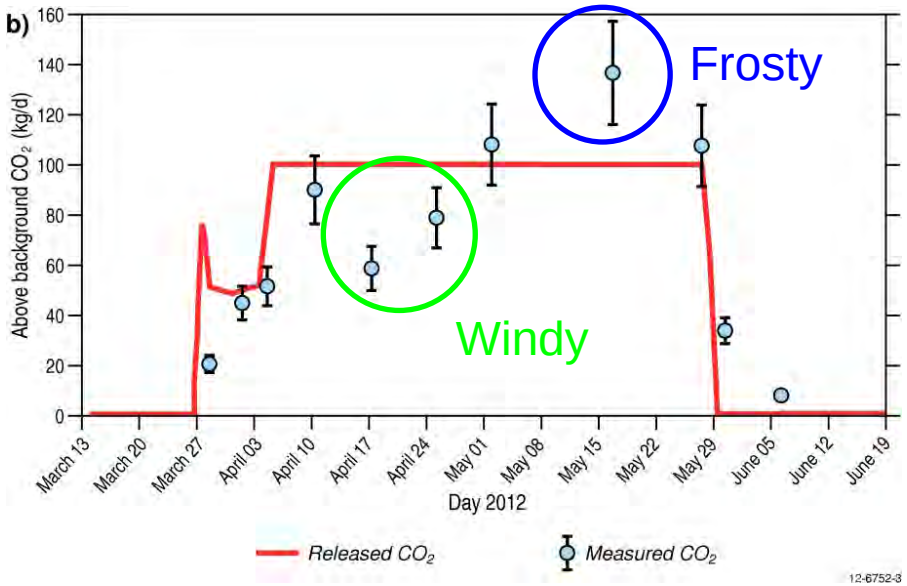
1st sub-surface release at Ginninderra (March – May 2012)

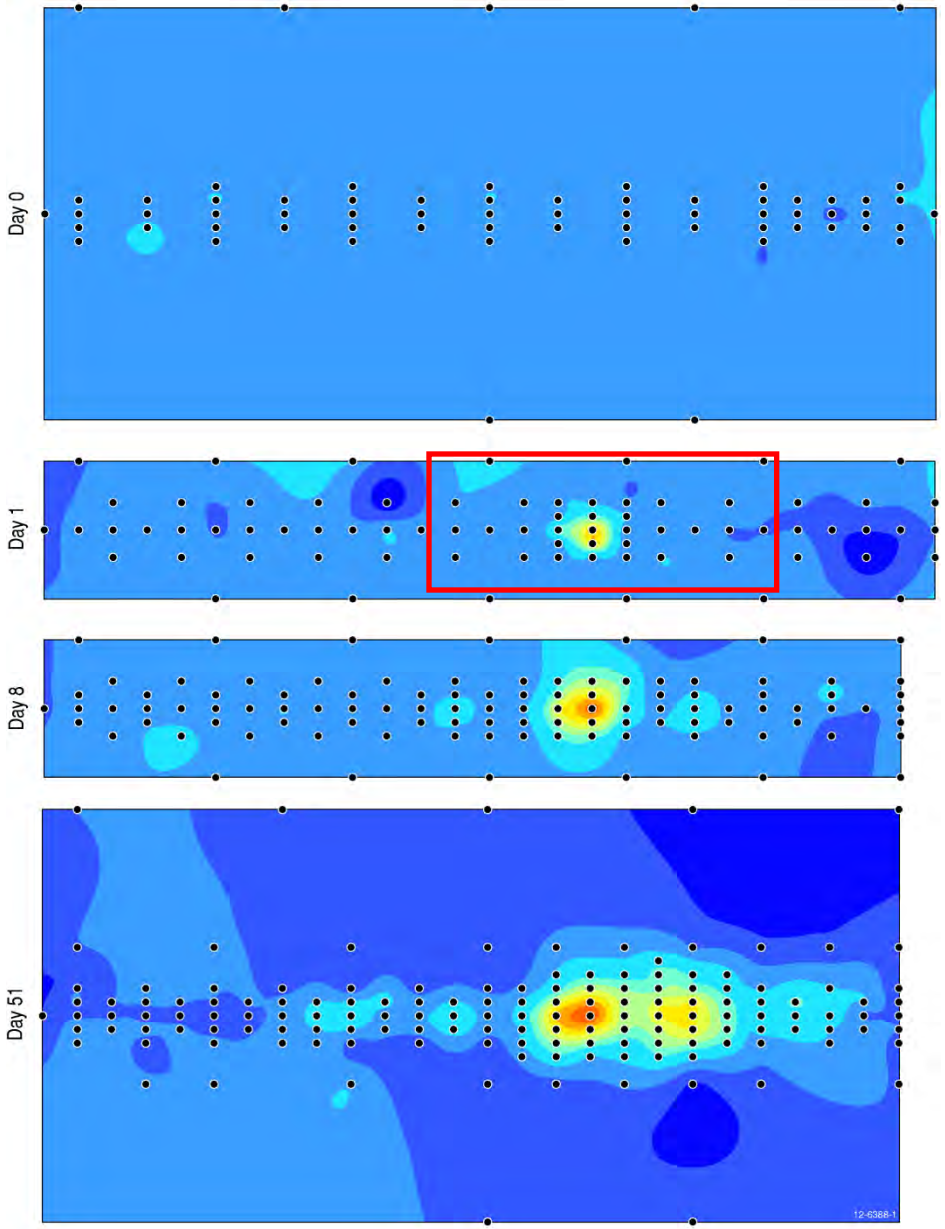
- Release rate 100 kg/d CO_2
- 8 x CO_2 (Vaisala GMP343) atmospheric sensors (solar powered, wireless network)
- 37 x 1m deep soil gas wells (8 surveys: CO_2, CH_4, C-13, N_2, O_2)
- Soil flux ~ 150 sample sites
- Eddy covariance (LICOR) tower
- Kr tracer (released in one chamber; soil gas, atmospheric samples)
- Electromagnetic survey (EM31)
- Soil community DNA analysis (0, 3, 15, 30m transect)

Wireless atmospheric CO_2 sensor array - Ginninderra

Soil flux

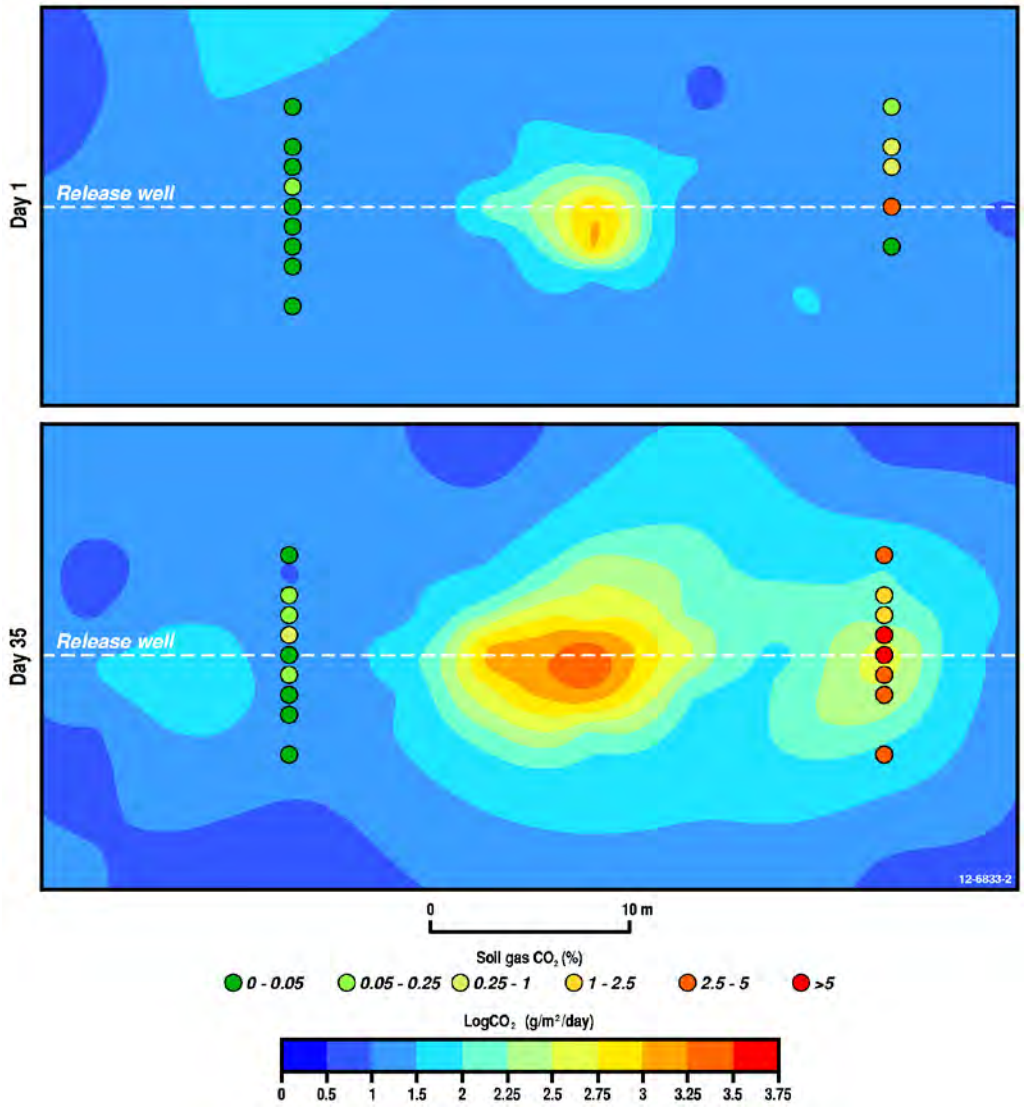
- **Soil flux took ~4 weeks to stabilise**
- **Reasonable quantification**





Soil gas vs soil flux

- Detected changes in soil gas after only 4 hrs, 15m from hot spot
- Considerable lag between surface expression of soil flux and sub-surface soil gas (1m deep)
- Detected Kr tracer in 1m deep well, 30m from horizontal well
- Surface CO_2 expression much less than sub-surface footprint (not “V” shaped)



Challenge: locating a surface leak

- **Quantification ok, but finding leaks in the first place is tricky**
- **Model simulations suggest a diffuse leak (100mx100m) 1km from single atmospheric station needs to be ~50t/d before statistically detectable**
- **Point source ~ 20t/d at 1km**

GA-CSIRO Arcturus atmospheric baseline station, Central Queensland

2nd release at Ginninderra (Oct - Dec 2012)

Focus on finding leaks using surface techniques (100 kg/d)

- Airborne hyperspectral
- Ground penetrating radar
- In-field phenotyping
- Electromagnetic surveys
- Walking around!

Flying around?

- **UAV rotorcraft equipped with CO_2 sensor**

Photo courtesy of
Florian Poppa, ANU

Summary

- Important facility for testing concepts, technologies and approaches
- Results used as basis for up-scaling (e.g. atmospheric tomography, phenotyping, UAV)
- CO_2 surface expression less than sub-surface footprint (no “V”)
- Quantification techniques work but require significant processing
- Finding small surface leaks over large areas is challenging
- Looking for method cross-validation opportunities

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