ENOS EMISSION QUANTIFICATION TOOLS

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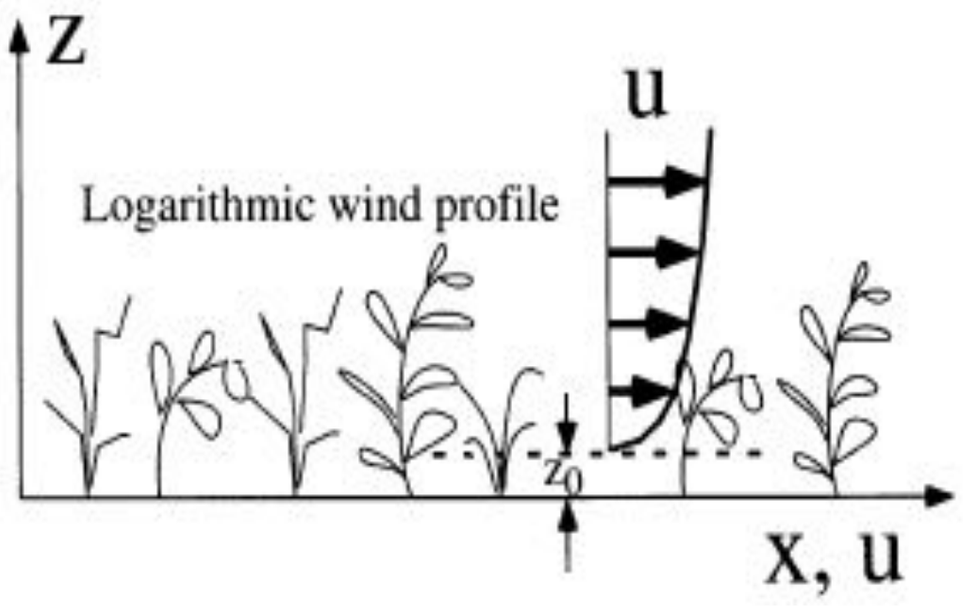
UniRoma1 Mapper – what are the principles behind it?



Oldenburg and Unger, 2004

- Soil gas or flux are point measurements, thus can be slow and have insufficient resolution to find and quantify a leak
- The surface boundary layer (Z_0) has little wind mixing, therefore a potential zone of accumulation for leaking CO_2
- Sampling this layer has the potential to be rapid, high resolution and spatially accurate
- Boundary layer concentration is related to flux rate, therefore Mapper results could be used as a proxy to estimate total emissions

Design and function of the UniRoma1 Mapper

- Unit is mounted on a cart that is pushed along a grid over the area of interest
- Pictured here with lasers, can be mounted on much smaller cart
- System consists of a tube dragged on the ground surface, a pump, and a CO_2 sensor, as well as differential GPS, batteries, memory, and control electronics.
- Measurements are made every second, giving an along-trace sample spacing of about 1.5 m at normal walking speed
- Work is ongoing to maximise the signal-to-noise ratio and sensitivity, and minimise response time and memory effects

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Based on original idea in Annunziatellis et al., 2008 and Jones et al., 2009

Preliminary mapping results from UniRoma1 Mapper

- Excellent correlation between the point flux measurement results and the Mapper data collected in two different directions.
- 190 flux measurements took about 10 person hours, whereas the Mapper took only about 30 minutes
- Future work will include:
  - a linear array of Mappers to give higher resolution faster
  - mounting the Mapper on a robot for autonomous work

Preliminary quantification results from UniRoma1 Mapper

- An empirical relationship between boundary layer concentrations and point flux values is defined based on a few points representing the total range
- The formula is used to “convert” all of the Mapper data to flux, and this data set is used to estimate total flux
- At the same time the complete, true flux dataset is also used to estimate total flux
- Initial results yielded a Mapper estimate that was about 60% of the “true” flux
- Work is on-going to improve this result

What are the potential benefits of the UniRoma1 Mapper?

- Inexpensive, robust, simple to use
- Capable of covering large areas quickly
- Spatially accurate, as anomalies are measured directly above their source with no lateral transport by wind
- Can be used for both mapping and leakage quantification
- Potential use as a reconnaissance tool that helps focus detailed work with more sensitive tools (e.g. soil gas

Combine/compare Mapper with…

- **GasFinder 2 laser system**
- **Customised Los Gatos Research laser gas analyser**
  - **$CH_4/CO_2/H_2O + O_2$ continuous measurement**
  - **Mounted on Mapper cart**
- GasFinder 3 scanning open path lasers (c.f. Shell LightSource)
- Continuous monitoring flux chambers, EC and soil gas monitoring stations
- Quantification methods c.f. Ginninderra
- Traditional point measurements of flux and soil gas
- CLaDS vs GasFinder 3
- Multiple tools used in combination to validate/verify and reach ‘consensus’ on quantification

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- **CLaDS vs GasFinder 3**

CLaDS

Field prototype in development

Rutherford Appleton Laboratory/Mirico + BGS

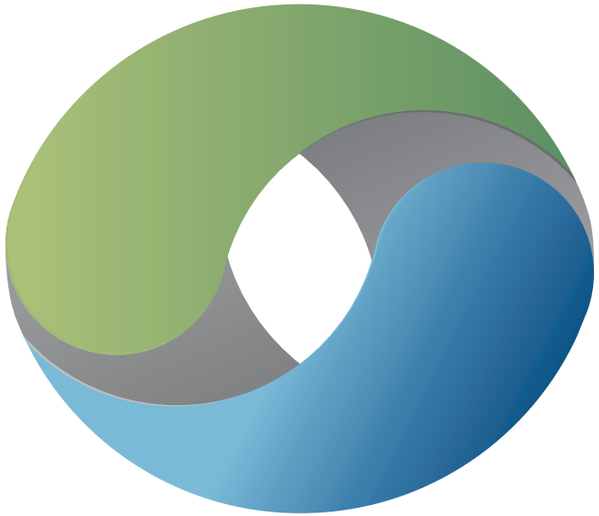
Detection of CO_2 surface flux over large areas

Combines open-path laser monitoring with an array of reflectors to detect and quantify leakage using tomographic reconstruction

Significantly improved precision over existing technologies

To be tested in controlled CO_2 release tests in the UK (STFC funded)

To be tested against new GasFinder 3 open path scanning laser



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Enabling Onshore CO_2 Storage

www.enos-project.eu

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