2025 May/June Controlled Release Testing Program

Overview and Useful Information

March 27, 2025

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SIMFLEX

SIMULATION FACILITY FOR LANDFILL EMISSION EXPERIMENTS

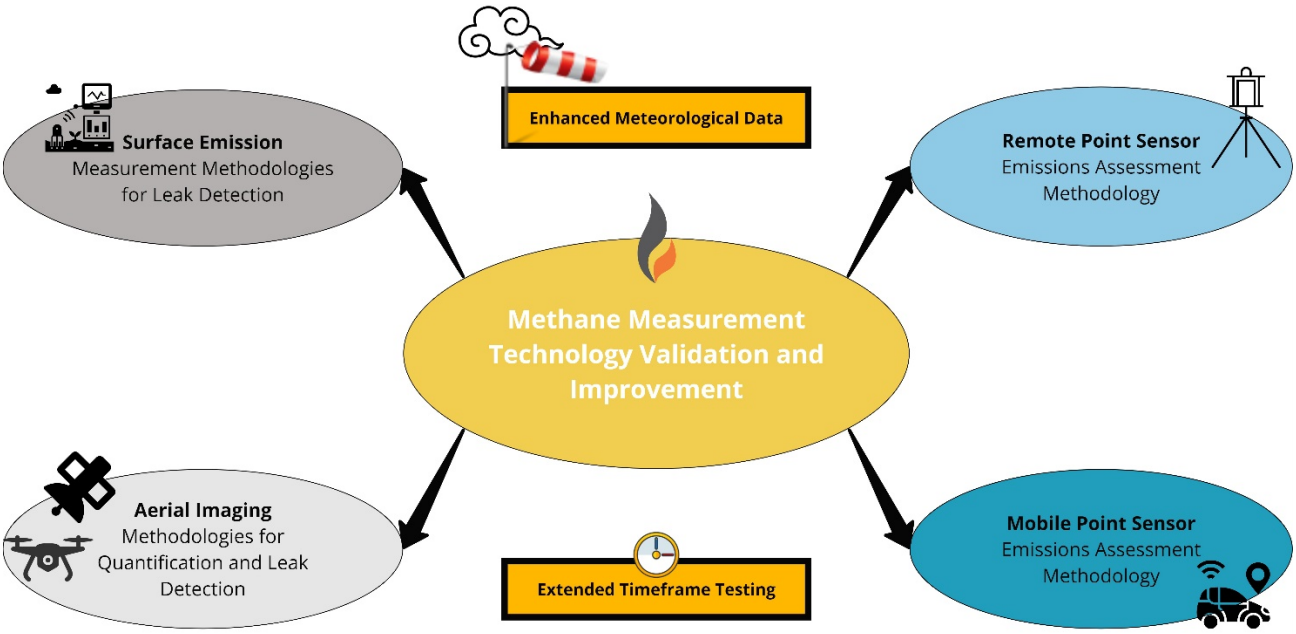
Evaluation of Measurement Technologies for Landfill Emissions Detection and Quantification

1. Background

This study aims to evaluate the accuracy and reliability of various methane measurement methodologies for leak detection and emission rate quantification at landfill sites. This study builds on the findings from similar studies conducted in 2023 and 2024. Key elements of the 2025 research program will include:

- Refinement of testing protocols to include more diverse conditions and methodologies
- Testing of methodologies that have not previously been tested
- Continued testing of select methodologies tested last year
- Continued focus on dispersed emissions from multiple emission areas
- Integration of enhanced meteorological data
- New experiments beyond traditional measurement hours (i.e. overnight)
- High sensitivity to the needs of all stakeholders as regulation is revamped across North America.

This year we will carry out the following experiments of the following type:



2. Location, Timing, and Funding

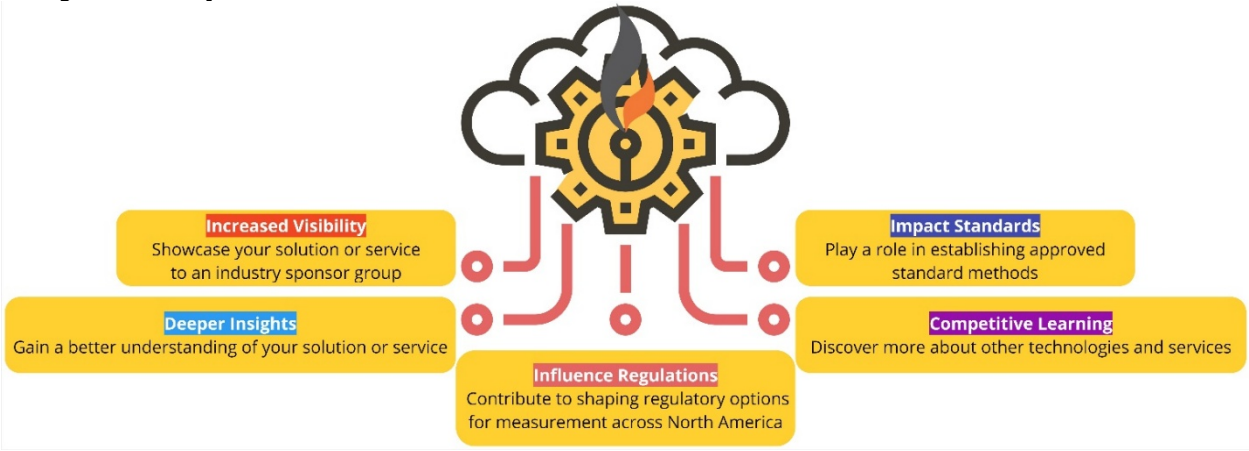
Location. The 2025 experiments will again be carried out in Petrolia, Canada, about 30 km from the US border and 150 km from Detroit. The site is a closed landfill owned and operated by WM.

Address. 4052 Oil Heritage Rd, Petrolia, ON N0N 1R0

Funding comes from the Environmental Research and Education Foundation, representing North American waste industry operators. Participants are expected to self-fund their participation in this study.

3. Timing. Phase 1 will occur from May 12–18, and phase 2 from June 2–15.

Why Participate?



4. Overview of Previous Experiment Results

Our initial controlled release study, conducted in 2023, provided useful and promising results. The project report is available via the Environmental Research and Education Foundation (EREF) here. We have also submitted a manuscript for peer review. Briefly, the results are as follows:

4.1. Quantification Methodologies

Quantification methodologies were assessed using controlled release rates of 0-300 kg/hr from up to 10 release points including area-based releases. Mobile tracer correlation showed high accuracy with minimal bias, establishing it as a reliable standard. LiDAR imaging overestimated emissions slightly but estimates improved with access to onsite meteorological data. Mobile Gaussian and airborne mass balance methods both showed a consistent and moderate underestimation bias. UAV Point Sensor Emission Assessments showed low bias but with differences in precision between participants. A satellite imaging sensor could unfortunately not detect or quantify emissions due to cloud cover and the highly distributed emissions. Continuous sensor network systems are still in early development, but we did see some promising results.

4.2. Detection Methodologies

Leak detection methodologies were assessed using much smaller controlled release rates, with some release points active at once. In leak detection experiments, LiDAR demonstrated a 100% detection probability even down to the lowest emission rates of 1 kg/hr. UAV column sensor emission assessments proved far less sensitive where emissions of 60-100 kg/hr were needed for detection at 90% probability. Neither could be compared against traditional surface emissions measurement surveys as site operating permits did not allow for walking within the temporary above ground pipeline network.

4.3. Other Observations

During the experiments, deployment flexibility affected the experimental schedule, as some methodologies could only operate under very specific conditions, whereas others could operate without downtime under any conditions.

5. Experimental Design for 2025

5.1. Controlled Release System Design and Installation

We will have eleven release nodes simulating point and dispersed emissions over 20 acres of closed landfill, with total release capacity of 840 kg/hr. Area-based emission points, where the releases will be distributed over large areas were made using lengths of perforated tubing. Each release node is computer controlled and logged. We will be releasing industrial natural gas, and not landfill gas. The system has been installed in 2024 in a more permanent fashion to decrease preparation time for future release campaigns.

5.2. Types of Experiments for 2025

The proposed experiments aim to refine emission detection and quantification methods across varying platforms, weather conditions, spatial dispersions, and work practices

A. Summer Sunshine (May 12-18, June 2-15)

Objectives: Evaluate detection and quantification accuracy under summer conditions
Methods included: Remote mobile Sensor Emission Assessment (RMSEA), Mobile Tracer Correlation Emission Assessment (MTCEA), UAV Column Sensor Emissions Assessment (UCSEA or UAV SEM) and Walking Surface Emission Measurement (Walking SEM or Walking EPA21 SEM), Remote Point Sensor Emission Assessment (RPSEA).
Focus: Repeating past November 2024 experiments to compare seasonal performance differences.
Key design elements: Consistent release patterns, diverse detection methods.

B. OTM51 Sniffer Drone (May 12-18)

Objectives: Determine if OTM51 drone surveys surpass walking in achieving 90% detection probability.
Methods included: UAV SEM, Walking SEM, Walking EPA21 SEM
Focus: Comparing drone-based OTM51 detection with walking under identical conditions.
Key design elements: Alignment with ongoing SEM experiments, ensure representative horizontal/vertical plume profiles.

C. General Detection and Quantification (May 12-18, June 2-15)

Objectives: Assess detection and quantification performance across varied rates and plume dispersal patterns.
Methods included: Remote mobile Sensor Emission Assessment (RMSEA), Mobile Tracer Correlation Emission Assessment (MTCEA), UAV Column Sensor Emissions Assessment (UCSEA or UAV SEM) and Walking Surface Emission Measurement

(Walking SEM or Walking EPA21 SEM), Remote Point Sensor Emission Assessment (RPSEA).
Focus: Broad evaluation of multiple technologies to observe performance variability
Key design elements: Conduct a wide range of releases under different environmental conditions.

D. SEM EPA21 Walking Alternative (June 2-15)

Objectives: Assess how different SEM work practices (spacing and height) impact detection outcomes.
Methods included: Walking EPA21 SEM
Focus: Testing theoretical model-informed adjustments to SEM methodology to optimize performance.
Key design elements: Varied emission patterns and rates, structured evaluations informed by EPA/ECCC input, evening assessments.

E. SEM UAV Column Sensors Standard Method Scoping (June 2-15)

Objectives: Test the feasibility and effectiveness of a proposed standard method for UAV column sensors SEM.
Methods included: UCSEA
Focus: Determining optimal spacing and settings to achieving a 90% detection probability benchmark (target 10 kg/hour)
Key design elements: Development and testing of standardized field method to ensure consistent plume detection criteria.

F. Aerial Imagers Detection and Quantification (June 2-15)

Objectives: Investigate detection capabilities of aerial imagers at varying remission densities and rates (e.g. 5, 10, 15 kg/hour/acre)
Methods included: Airborne Imaging Sensor Emission Assessment (AISEA)
Focus: Establishing detection limits and performance metrics for aerial imaging sensors.
Key design elements: Varied spatial emission patterns, diverse emission rates

G. Satellite Detection and Quantification (May 12-18, June 2-15)

Objectives: Determine satellite capabilities in detecting and quantifying methane emissions.
Methods included: Satellite Imaging Sensor Emission Assessment (SISEA)
Focus: Assessing how plume concentration density and dispersion affect detection from satellites.
Key design elements: Adjust emission rate density based on satellite detection feedback, flexible emissions configuration, emission rate reductions based on early results.

6. Participation Requirements

6.1. Methodology Questionnaire

The methodology questionnaire asks participants for detailed information about their emission detection systems, including system configuration, safety measures, and operational details like setup time, survey duration, and weather limitations. It also covers personnel requirements, cost estimates, and the system's ability to operate near high-concentration leak points safely. Participants need to provide specifics on their

equipment, including model numbers and software revisions, and explain their data confidence levels. This helps assess the system's reliability, efficiency, and suitability for the project. The questionnaire can be found **here**.

6.2. Health and safety

At FluxLab, safety comes first! It's the solid base that supports all our work. You can learn more about what is expected and required on our **website** if you scroll down to **Safety Training & Documents.**

6.3. Agreements

All project participants are required to sign a participation agreement and provide proof of required insurance. On our website scroll down to **Research Participation Agreements**.

6.4. Experimental Protocol

We should all align on the science we're developing! To ensure this, we'll provide you with detailed information in our **Experimental Protocol**.

7. Electronic Resources

Link: https://fluxlab.ca/simflex/

Information for Participants 2025

- **Overview:** Includes documents with General description and Frequently Asked Questions.
- **Participation Documents:** Offers Participant-Questionnaire and Experimental Protocol, and Overview and Methodology Framework.
- **Participation agreements:** Agreements for various participants.
- **Site Safety Training and Documents:** Includes WM training information, Fire Safety and Emergency Preparedness and Response Plan, Petrolia Landfill safety briefing, and additional safety documents provided by FluxLab and EREF.
- **Site Pictures:** Provides visual references of the project site for planning and documentation.
- **Wind Data Analysis File:** Contains wind data analyses, wind roses and dominant wind directions and possible down wind sides.

8. Contact Information

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