Development of the Mobile Tracer Correlation Approach for Quantification of Emissions from Landfills and Other Large Area Sources

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Background

- Large area sources like landfills present many emissions measurement challenges:
  - Large in extent, spatially variable emissions
  - Temporally variable, difficult to model
- Measurement tools such as flux boxes and EPA OTM 10 provide a "picture" of emissions from parts of a landfill
- A technique that provides whole-facility emissions measurements is a valuable complementary tool

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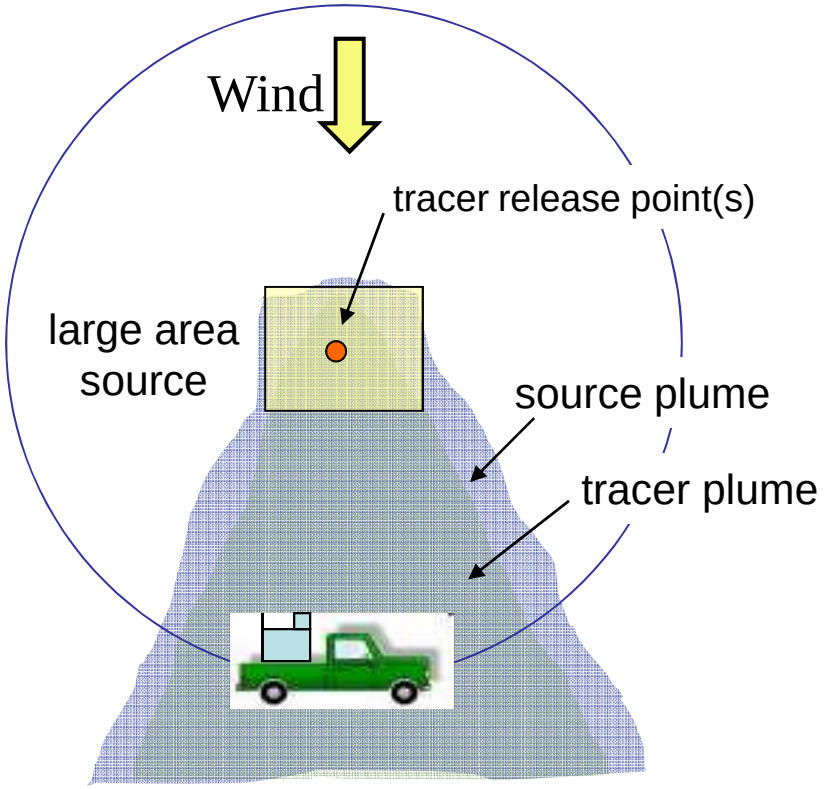
Background

- Tracer correlation is a simple approach for measuring large area source emissions
- Use mobile monitor to map target source and tracer plumes
- Calculate dilution ratio based on known tracer release rate



Background

- Conventional tracer correlation equipment used in the literature is rather complicated (Quantum cascade lasers and FTIRs)
- This projects tests the tracer correlation approach with high performance but simple to use instruments and with acetylene as a tracer release gas
- This work supports development of an EPA preliminary method for tracer correlation measurement of large area sources
- This method is part of EPA's Geospatial Measurement of Air Pollution (GMAP) Program. It is called Remote Emissions Quantification by Tracer Correlation (REQ-TC)

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Background:
GMAP-REQ-TC Calculation

$$Q_m = Q_t \left(\frac{\Delta C_m}{\Delta C_t} \right)$$

Where:

- Q_m = whole-facility methane emission rate
- Q_t = tracer gas release rate
- ΔC_m = elevation of methane concentration above background levels
- ΔC_t = elevation of tracer gas concentration above background levels

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Project Timeline

- **Campaign 1** (2009)
  - Proof-of-concept and
  - determination of analytical performance
- **Campaign 2** (2010)
  - Development of sampling/on-site procedure
- **Campaign 3** (2011)
  - Data processing and analysis
- **Campaign 4** (2012)
  - Improvement in the efficiency of method application and
  - quantification of measurement uncertainty

Project Timeline:

Real-world Field Work by Industry

Dates	Facility	Location
Campaign 1		
May 18 – 21, 2009	Twin Bridges	Danville, IN
October 5 – 7, 2009	Redwood	Novato, CA
October 18 – 22, 2009	Altamont	Livermore, CA
Campaign 2		
July 21 – 23, 2010	Twin Bridges	Danville, IN
July 30, 2010	Outer Loop	Louisville, KY
August 17 – 18, 2010	Twin Bridges	Danville, IN
August 24 – 26, 2010	Stony Hollow	Dayton, OH
August 31 – September 2, 2010	Suburban	Glenford, OH
September 8 & 10, 2010	Outer Loop	Louisville, KY
September 14 – 15, 2010	Twin Bridges	Danville, OH
September 16 – 17, 2010	South Wells	Liberty Center, IN
September 21 – 22, 2010	Stony Hollow	Dayton, OH
September 23, 2010	Springfield	Springfield, OH
October 19 – 21, 2010	Springfield	Springfield, OH
October 26 – 27, 2010	Stony Hollow	Dayton, OH
November 2, 2010	Seneca East	Republic, OH
November 4, 2010	South Wells	Liberty Center, IN
November 9 – 10, 2010	Centerpoint	Centerpoint, IN
November 11 – 12, 2010	Twin Bridges	Danville, IN
November 16 – 17, 2010	Suburban	Glenford, OH
December 1 – 2, 2010	Outer Loop	Louisville, KY

Dates	Facility	Location
Campaign 3		
June 1 – 3, 2011	Turkey Run	Lone Oak, GA
June 14 – 16, 2011	Turkey Run	Lone Oak, GA
August 9 – 10, 2011	Centerpoint	Centerpoint, IN
August 24 – 25, 2011	Twin Bridges	Danville, IN
August 31, 2011	South Wells	Liberty Center, IN
September 7 – 8, 2011	Centerpoint	Centerpoint, IN
September 13 – 14, 2011	Twin Bridges	Danville, IN
September 21 – 22, 2011	South Wells	Liberty Center, IN
October 11 – 12, 2011	Centerpoint	Centerpoint, IN
October 25, 2011	South Wells	Liberty Center, IN
November 2 & 4, 2011	Twin Bridges	Danville, IN
November 16 – 18, 2011	Turkey Run	Lone Oak, GA
November 30, 2011	Centerpoint	Centerpoint, IN
December 1, 2011	Twin Bridges	Danville, IN
December 6, 2011	South Wells	Liberty Center, IN
December 14 & 16, 2011	Valencia	Los Chavez, NM
Campaign 4		
TBD		

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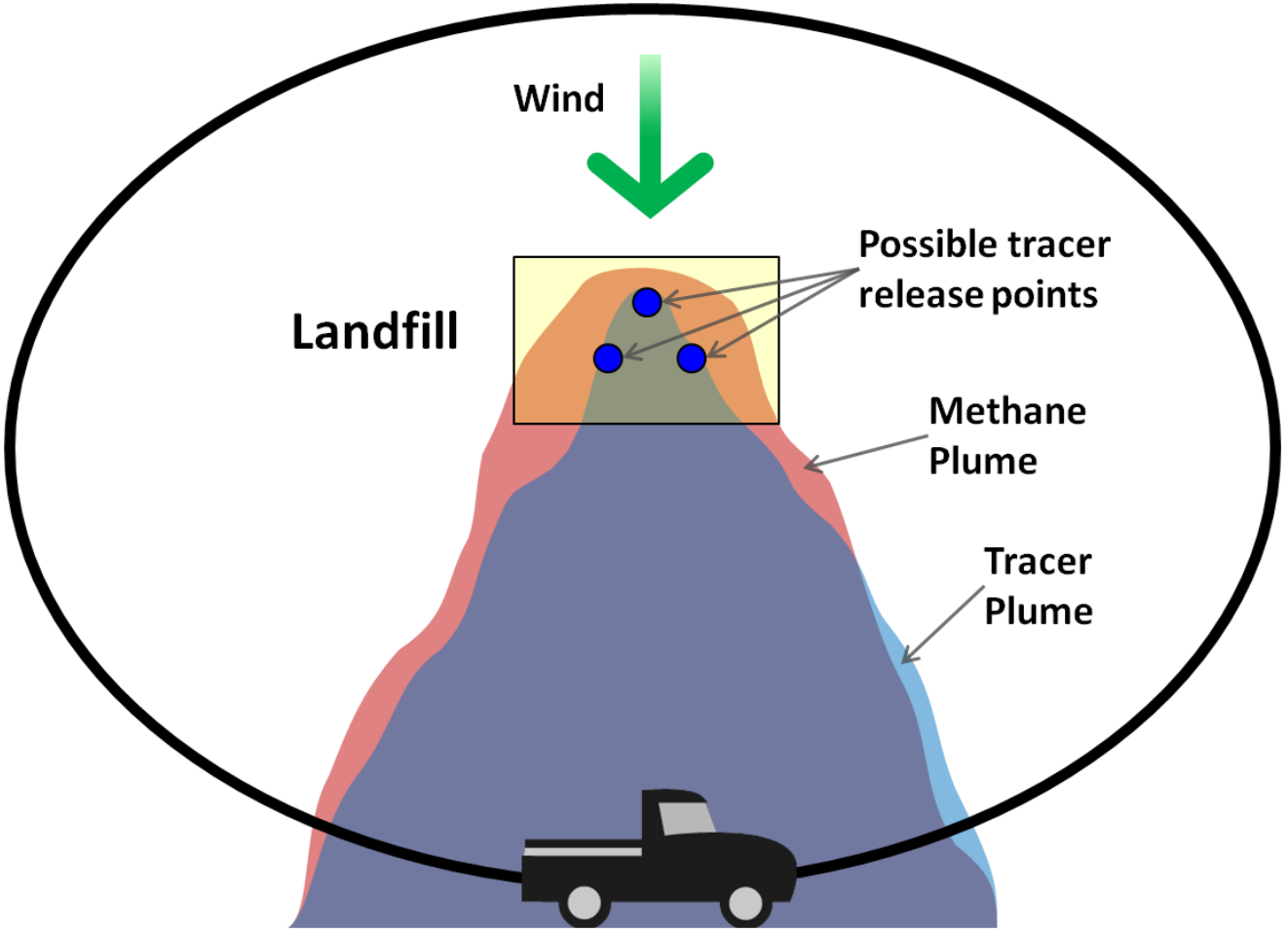
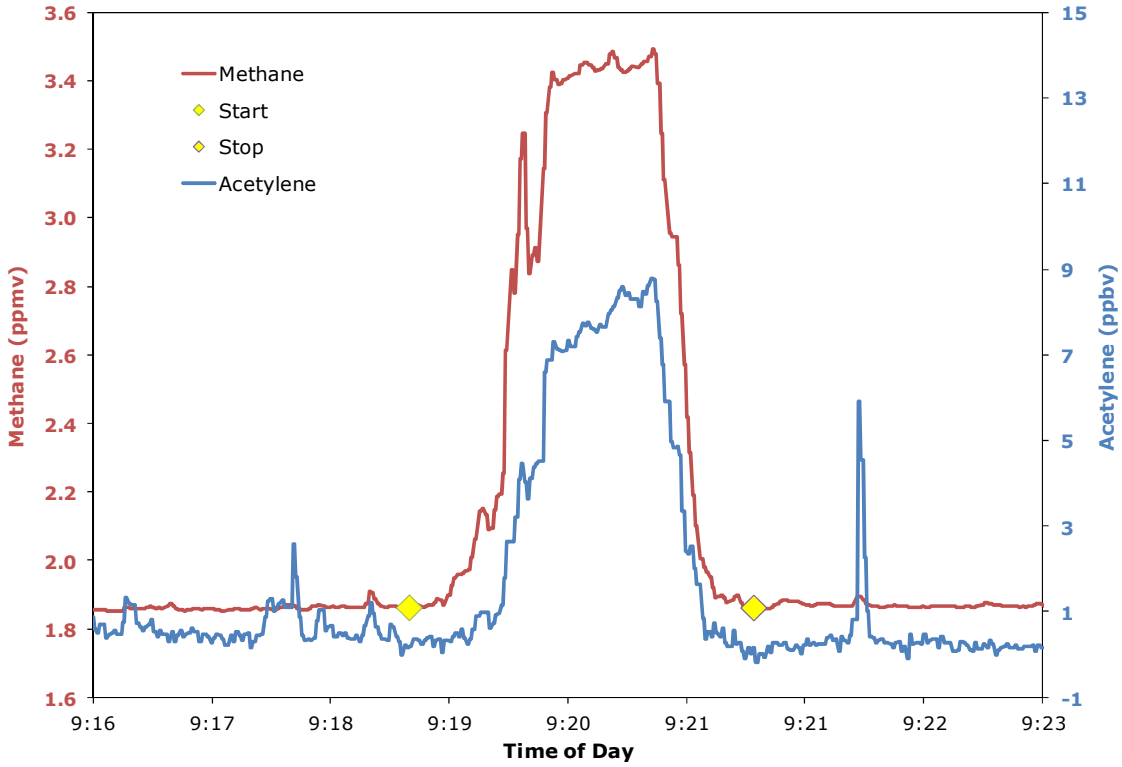
Campaign 1: Proof-of-Concept

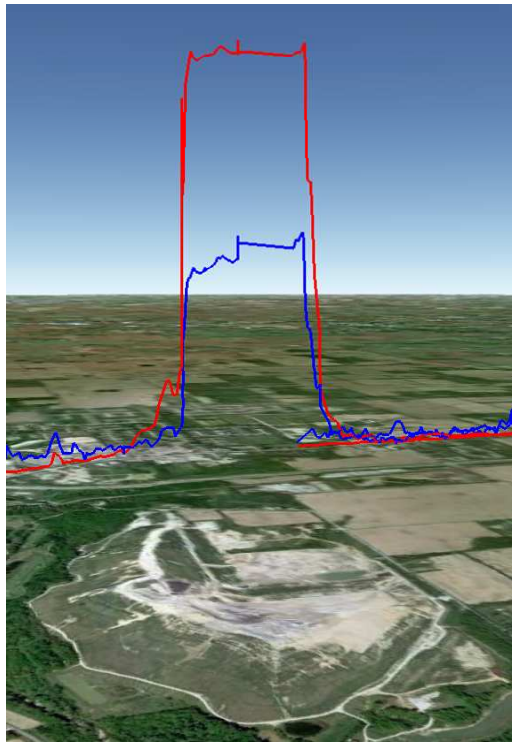
(Can we perform TC with simple instruments?)



Campaign 1: Proof-of-Concept

(Can we perform TC with simple instruments?)



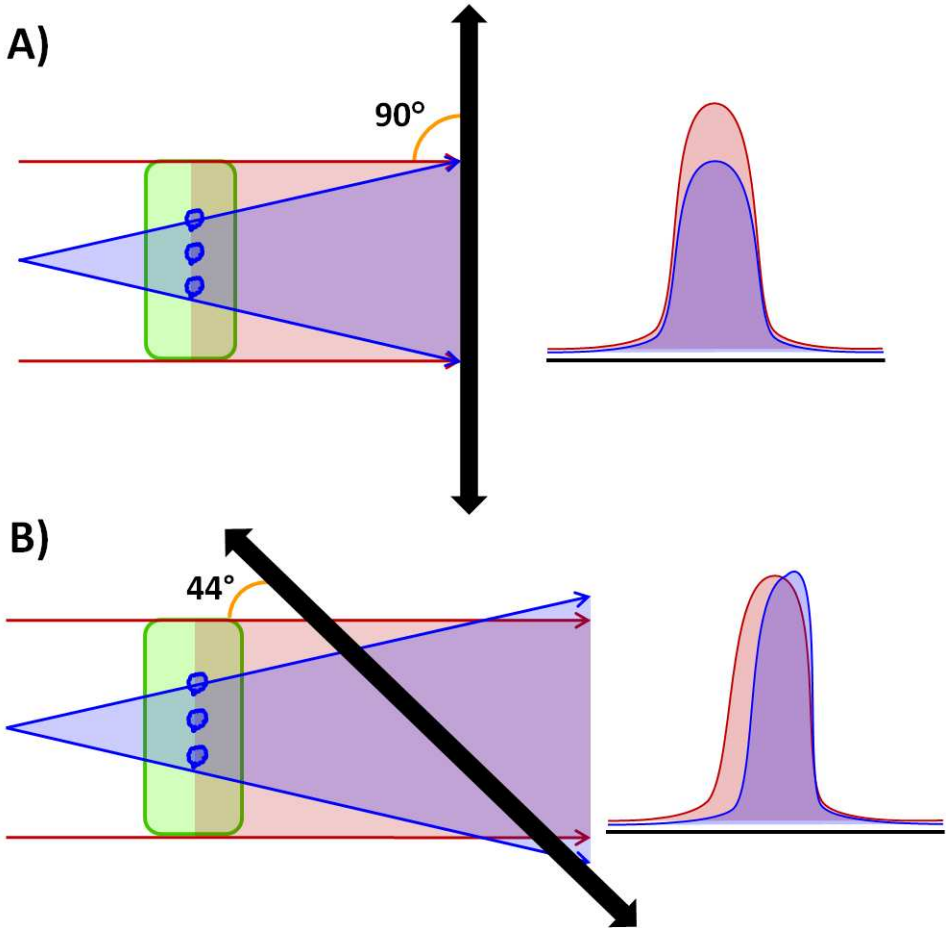


Work with Picarro Inc. to develop and test a simple approach for TC work. A single CRDS instrument to measure methane and acetylene and record meteorological and GPS location data.

Campaign 2:
Measurement Quality Objectives (MQOs)

Measurement Parameter	MQO
GPS Data Acquisition	TBD*
Proper MFC Function	MFC release rate within ±20% of cylinder weight-determined release rate *
Wind Speed	> 1.8 km/h
Instrumental Performance: Methane	Accuracy: ± 5% Drift: ± 2%
Instrumental Performance: Acetylene	Accuracy: ± 10% Drift: ± 2%
Instrumental Performance: Resolution	< 2.0 seconds
Mobile Path: Distance from Landfill Midpoint	> 0.65 km
Mobile Path: Absolute Angle	Ideally 90°, but no less than 45°

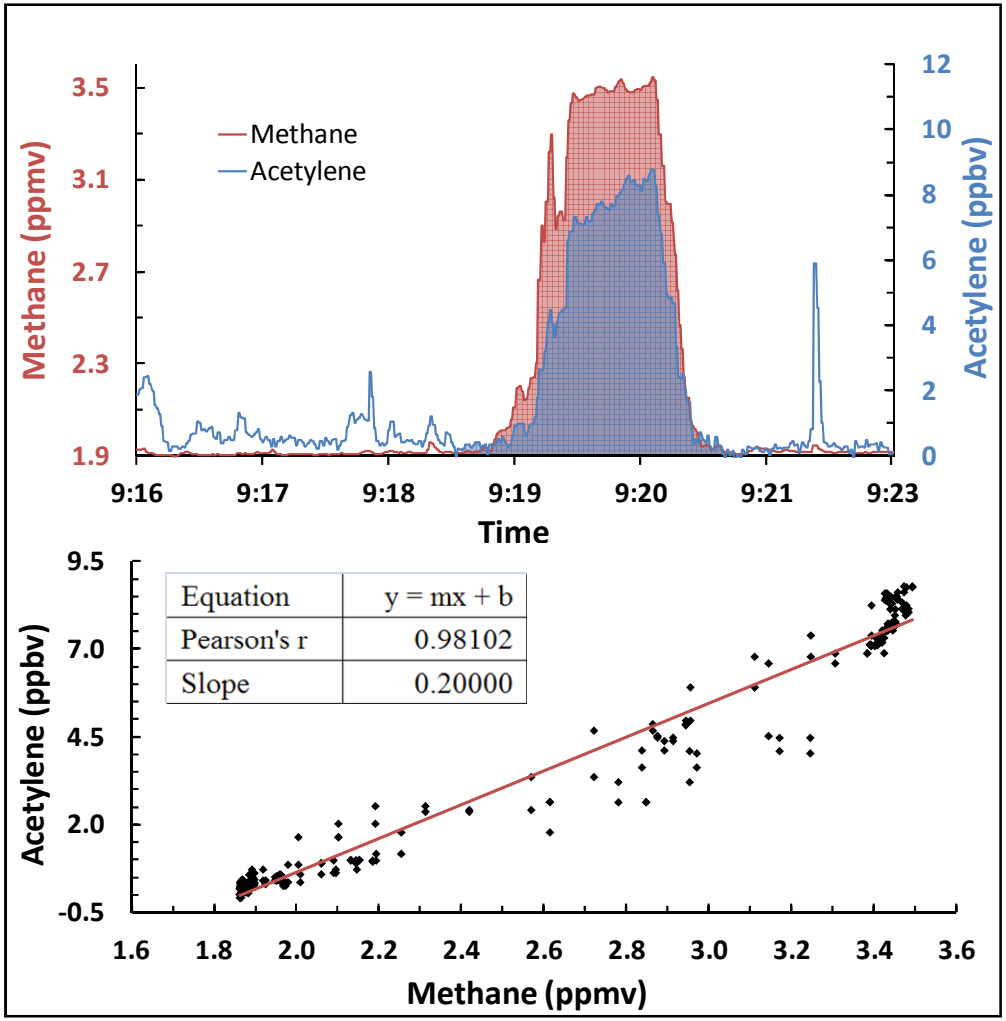
Campaign 2:
Determining MQOs



Campaign 3:
Data Quality Indicators (DQIs)

Measurement Parameter	DQI Specification
Distance from Landfill Midpoint	> 0.65 km
Direction Relative to Landfill Midpoint	± 60°
Relative Percent Difference (RPD): Mobile Transects	< 20%
RPD: Stationary Measurements	< 40%
Pearson Correlation Coefficient	Mobile: > 0.80 Stationary: > 0.75
Wind Speed	TBD*
Wind Direction	TBD*
S:N Ratio	TBD*

Campaign 3:
Determining DQIs



Campaign 4:
Refining the Method

- Working with industry to further refine method application (what works in the real world)
- Improved sample inlet and met station design
- Improved data collection, processing, and analysis software
- Addressing transferability and QA protocols

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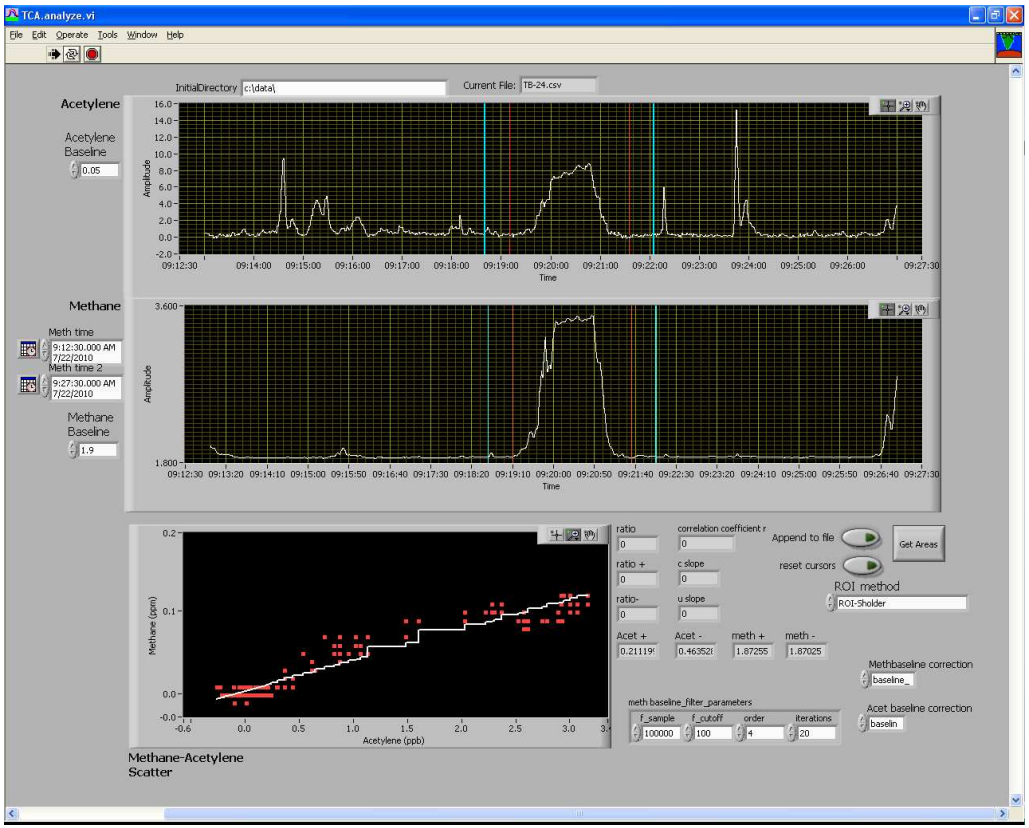
Campaign 4: (Refining to Practice)

Example Improvements



Summary

- Work has shown that the GMAP REQ TC approach using simple (but powerful) spectroscopic instruments and acetylene as a tracer is useful
- The approach is “out of the lab” and is being tested in the field by industry
- The approach very transferable and is being documented as a method for submission to EPA OAQPS for posting consideration as an alternate test method for area sources (2013)

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The End

- Thank you!
- Any questions?