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D-fenceline measurement systems

Advanced Management tool to control your emissions

Gilad Shpitzer, CEO, Atmosfir Optics Ltd.

5/11/2016

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Atmosfir Optics

World leader in wide-area, real-time air monitoring

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Atmosfir Optics Ltd. is an innovative, advanced air monitoring technology company focused on providing complete, fully-automated and long-term air monitoring solutions to manage air quality resource.

- Atmosfir's leadership team includes some of the world's most experienced scientists in the field of advanced air monitoring and remote sensing.
- For over fifteen years our experts have been actively involved in the development of USEPA relevant test methods and in the vast majority of Optical Remote Sensing (ORS) studies using OP-FTIR and Radial Plume Mapping (RPM) techniques.
- We develop, design and integrate advanced air monitoring solutions using our proprietary patent technologies and software.

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Patents

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(12) **United States Patent**
Yost et al.

(10) **Patent No.: US 6,542,242 B1**
(45) **Date of Patent: Apr. 1, 2003**

(54) **MAPPING AIR CONTAMINANTS USING PATH-INTEGRATED OPTICAL REMOTE SENSING WITH A NON-OVERLAPPING VARIABLE PATH LENGTH BEAM GEOMETRY**

(75) Inventors: **Michael G. Yost**, Mercer Island, WA (US); **Ram A. Hashmonay**, Chapel Hill, NC (US)

(73) Assignee: **University of Washington**, Seattle, WA (US)

Primary Examiner—Samuel A. Turner
(74) *Attorney, Agent, or Firm*—Ronald M. Anderson

(57) ABSTRACT

Path Integrated Optical Remote Sensing (PI-ORS) instruments are used to provide Path Integrated Concentration (PIC) data corresponding to a particulate concentration in region scanned by a sequence of optical beams. Prior art methods of developing spatial concentration maps using PIC data have required a relatively large number of intersecting beam paths. The present invention can produce spatial concentration maps using considerably fewer optical beams.

(12) **United States Patent**
Hashmonay

(10) **Patent No.: US 7,501,629 B2**
(45) **Date of Patent: Mar. 10, 2009**

(54) **FENCELINE MONITORING OF AIR CONTAMINANTS**

6,776,523	B2	8/2004	Simunovic et al.	
2006/0203248	A1 *	9/2006	Reichardt et al.	356/437

OPIC CIPO

(11) (C) 2,087,439
(86) 1991/07/15
(43) 1992/01/17
(45) 1996/07/09

(51) Int.Cl. G01N 21/35

(19) (CA) **CANADIAN PATENT** (12)

(54) FTIR Remote Sensor Apparatus and Method

(72) Simpson, Orman A. , U.S.A.
Kagann, Robert H. , U.S.A.

US008502152B1

(12) **United States Patent**
Hashmonay et al.

(10) **Patent No.: US 8,502,152 B1**
(45) **Date of Patent: Aug. 6, 2013**

(54) **METHOD FOR OPEN PATH DETECTION OF AIR CONTAMINANTS**

(71) Applicant: **Atmosfir Optics Ltd**, Ein Iron (IL)

(72) Inventors: **Ram Hashmonay**, Chapel Hill, NC (US); **Robert Howard Kagann**, Cumming, GA (US); **Gilad Shpitzer**, Ein Iron (IL); **Yair Shpitzer**, Jerusalem (IL); **Michael James Chase**, Raleigh, NC (US)

(73) Assignee: **Atmosfir Optics Ltd.**, Ein Iron (IL)

6,483,113	B1 *	11/2002	Sealy et al.	250/339.08
6,542,242	B1 *	4/2003	Yost et al.	356/450
7,229,833	B1 *	6/2007	Andersson	436/73
7,501,629	B2 *	3/2009	Hashmonay	250/339.08
2006/0246592	A1 *	11/2006	Hashmonay	436/57
2007/0045542	A1 *	3/2007	Hashmonay	250/339.12

* cited by examiner

Primary Examiner — David Porta
Assistant Examiner — Casey Bryant
(74) *Attorney, Agent, or Firm* — Soroker-Agmon; Daniel Schatz

US 20060246592A1

(19) **United States**
(12) **Patent Application Publication**
Hashmonay

(10) **Pub. No.: US 2006/0246592 A1**
(43) **Pub. Date: Nov. 2, 2006**

(54) **IDENTIFICATION OF LOW VAPOR PRESSURE TOXIC CHEMICALS**

(75) Inventor: **Ram A. Hashmonay**, Chapel Hill, NC (US)

Publication Classification

(51) **Int. Cl.**
G01N 33/00 (2006.01)
(52) **U.S. Cl.** 436/57

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ARE WE UNDER THE GUN?

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325A/B

Bay Area Air Quality Management District

Root cause analysis

Fortnight average

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Recent changes in US legislation

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NATIONAL ARCHIVES AND RECORDS ADMINISTRATION
LITTERA SCRIPTA MANET
1985

FEDERAL REGISTER

Vol. 80 Tuesday,
No. 230 December 1, 2015

Part II

Environmental Protection Agency

40 CFR Parts 60 and 63
Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards; Final Rule

(k) As outlined in § 63.7(f), the owner or operator may submit a request for an alternative test method. At a minimum, the request must follow the requirements outlined in paragraphs (k)(1) through (7) of this section.

(4) The spatial coverage must be equal to or better than the spatial coverage provided in Method 325A of appendix A of this part.

(i) For path average concentration open-path instruments, the physical path length of the measurement shall be no more than a passive sample footprint (the spacing that would be provided by the sorbent traps when following Method 325A). For example, if Method 325A requires spacing monitors A and B 610 meters (2000 feet) apart, then the physical path length limit for the measurement at that portion of the fenceline shall be no more than 610 meters (2000 feet).

(ii) For range resolved open-path instrument or approach, the instrument or approach must be able to resolve an average concentration over each passive sampler footprint within the path length of the instrument.

(iii) The extra samplers required in Sections 8.2.1.3 of Method 325A may be omitted when they fall within the path length of an open-path instrument.

(5) At a minimum, non-integrating

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Recent Changes in US Legislation

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BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

Air Monitoring Guidelines for Petroleum Refineries

AIR DISTRICT REGULATION 12, RULE 15: PETROLEUM REFINING EMISSIONS TRACKING

1.1 Fence-line Monitoring

Refinery operators must measure **benzene, toluene, ethyl benzene, and xylenes (BTEX)** and **H_2S** concentrations at refinery fence-lines with open path technology capable of measuring in the parts per billion range regardless of path length. Open path measurement of **SO_2, alkanes or other organic compound indicators, 1, 3-butadiene**, and **ammonia** concentrations are to be considered in the Air Monitoring Plan. Refinery operators must provide a rationale in the Air Monitoring Plan for not measuring all of the above compounds that addresses: why these compounds are not be contained in the compositional matrix of emissions; are not at expected concentrations measured by available equipment; and/or, address the technical or other considerations that make specific measurements inappropriate or unavailable.

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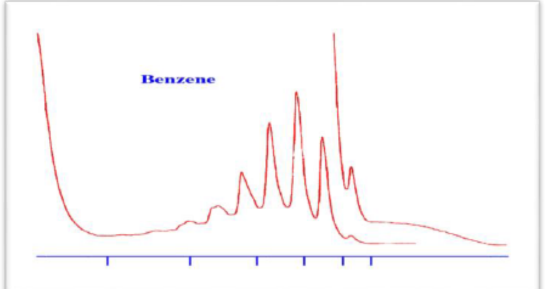
From US-EPA Presentation - Refinery Fenceline Monitoring& Method 325A/B

Alternative Methods

- 40 CFR 63.658 (k)
  - Can be used for all or a number of passive samplers
  - MDL must be <=0.9 ug/m3
  - Spatial coverage must be equal to M325A
    - Physical path length for open path systems must be equal to M325 spacing
    - Open path instruments must be able to resolve an average concentration over each passive sampler footprint within the path length of the instrument
  - Non-integrating alternative methods must provide a minimum of one cycle of operation for each successive 15-minute period
  - Real time alternative methods may be used to eliminate outside confounding sources
  - All results measured under MDL must use MDL for “high reading”; “0” for “low reading”.



16

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From US-EPA Presentation - Refinery Fenceline Monitoring& Method 325A/B

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API/AFPM Study October 2014

submitted as comment

- API did a 12 refinery study using passive monitoring over 6 weeks
- Study showed the fenceline approach can be implemented, and produces good data
- We see the same gradients as with our data, and the same stable readings
- Sources or locations of high benzene are apparent
- Consistent benzene background levels in relation to action level
- Cost of the program consistent with our estimates
- Trigger is reasonable
- Data shows reductions will occur at sites from implementing the program
  - 3 of the 12 sites had readings that approach our trigger
  - Study was conducted over the winter months

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D-fenceline System – Technology Principles

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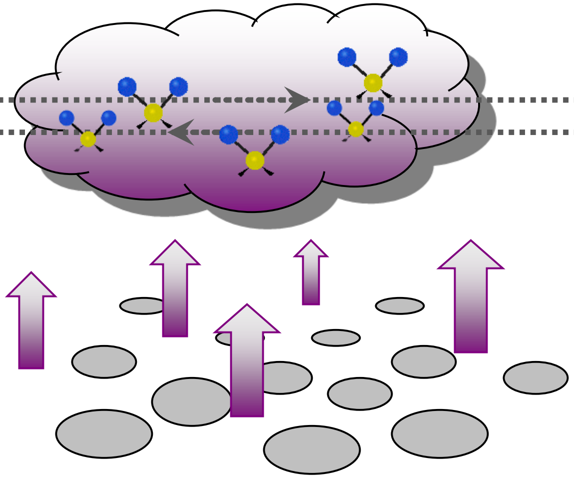
Retroreflector



Nonlocalized Emission Source

ORS
Source/Detector
(monostatic)

$$A_{(v)}=K_{(v)}CL=-\ln[I/I_0]$$

Open-path instruments provide path-averaged concentration data

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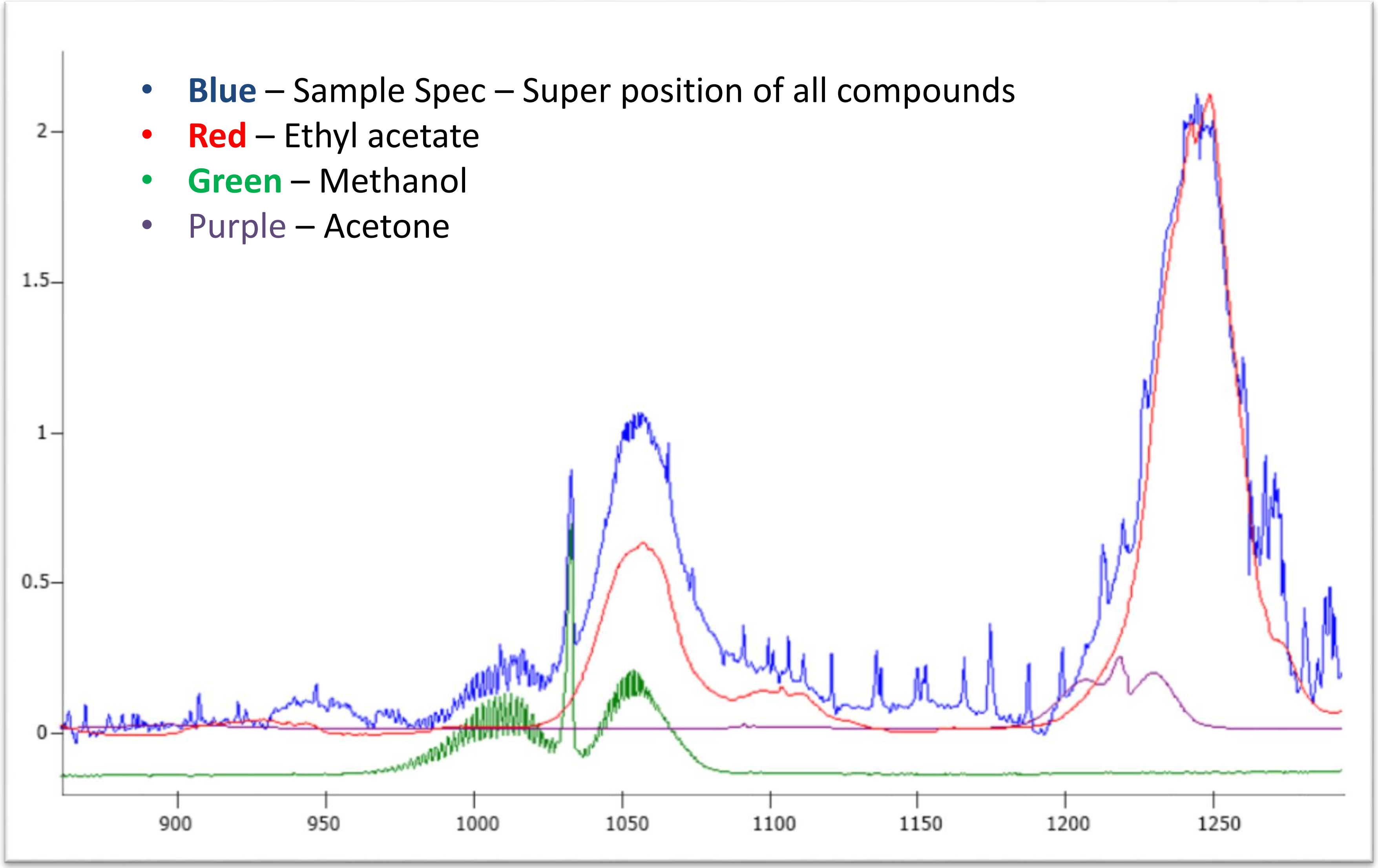
Spectral Fingerprint



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Unprecedented DL

- Using our D-fenceline system, compounds which is in the past could not be detected by IR systems can easily identified reliably in sufficient detection limit.

Typical System's Sensitivity (200 - 400 meters Pathlength)		
Compound	**Quantification Limit [ppb] (5 min average)**	**Quantification Limit [ppb] (1 hour average)**
1,3-Butadiene	1	0.3
Acrylonitrile	2	0.7
Ammonia	0.5	0.2
Benzene	**3**	**0.5 ***
Carbon Tetrachloride	0.5	0.2
Ethylbenzene	20	7
Ethylene	1	0.3
Methane**	5	2
Methylene Chloride	1	0.3
m-Xylene	3	1
Nitrogen Dioxide	5	2
o-Xylene	3	1
Propylene	1	0.3
p-Xylene	3	1
Sulfur Dioxide	5	2
Toluene	5	2
Total-Alkanes	2	0.7
Vinyl Chloride	1	0.3

*above atmospheric background

*Single Path Data collection

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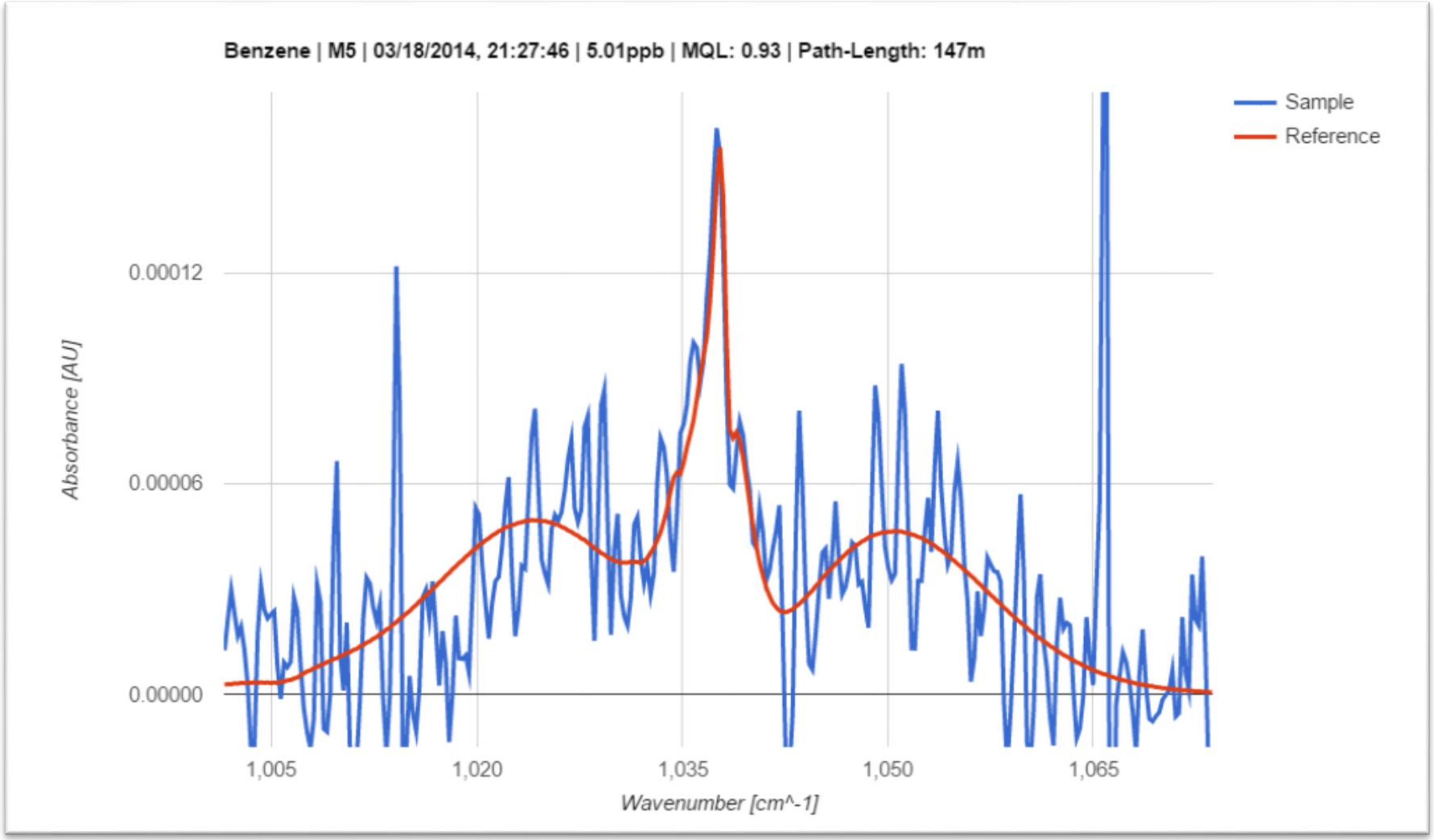
Benzen - Spectral Validation



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OP-FTIR Methods and Procedures

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EPA/625/R-96/010b

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air

Second Edition

Compendium Method TO-16

Long-Path Open-Path Fourier Transform Infrared Monitoring Of Atmospheric Gases

Center for Environmental Research Information
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, OH 45268

January 1999

ASTM INTERNATIONAL

Designation: E 1865 – 97 (Reapproved 2002)

Standard Guide for Open-Path Fourier Transform Infrared (OP/FT-IR) Monitoring of Gases and Vapors in Air[1]

This standard is issued under the fixed designation E 1865; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide describes active open-path Fourier transform infrared (OP/FT-IR) monitors and provides guidelines for using active OP/FT-IR monitors to obtain concentrations of gases and vapors in air.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

E 131 Terminology Relating to Molecular Spectroscopy[2]

E 168 Practice for General Techniques of Infrared Quantitative Analysis[2]

E 1421 Practice for Describing and Measuring Performance of Fourier Transform Mid-Infrared (FT-MIR) Spectrometers Level Zero and Level One Tests[2]

E 1655 Practices for Infrared, Multivariate, Quantitative Analysis[2]

3. Terminology

3.1 For definitions of terms relating to general molecular spectroscopy used in this guide refer to Terminology E 131. A complete glossary of terms relating to optical remote sensing is given in Ref (**1**).[3]

3.2 *Definitions:*

3.2.1 *background spectrum, n*—a single-beam spectrum that does not contain the spectral features of the analyte(s) of interest.

3.2.2 *bistatic system, n*—a system in which the IR source is some distance from the detector. For OP/FT-IR monitoring, this implies that the IR source and the detector are at opposite ends of the monitoring path.

3.2.3 *monitoring path, n*—the location in space over which concentrations of gases and vapors are measured and averaged.

3.2.4 *monitoring pathlength, n*—the distance the optical beam traverses through the monitoring path.

3.2.5 *monostatic or unistatic system, n*—a system with the IR source and the detector at the same end of the monitoring path. For OP/FT-IR systems, the beam is generally returned by a retroreflector.

3.2.6 *open-path monitoring, n*—monitoring over a path that is completely open to the atmosphere.

3.2.7 *parts per million meters, n*—the units associated with the quantity path-integrated concentration and a possible unit of choice for reporting data from OP/FT-IR monitors because it is independent of the monitoring pathlength.

3.2.8 *path-averaged concentration, n*—the result of dividing the path-integrated concentration by the pathlength.

3.2.8.1 *Discussion*—Path-averaged concentration gives the average value of the concentration along the path, and typically is expressed in units of parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter ($\mu g m^{-3}$).

3.2.9 *path-integrated concentration, n*—the quantity measured by an OP/FT-IR monitor over the monitoring path. It has units of concentration times length, for example, ppm-m.

3.2.10 *plume, n*—the gaseous and aerosol effluents emitted from a stack or other pollutant source and the volume of space they occupy.

3.2.11 *retroreflector, n*—an optical device that returns radiation in directions close to the direction from which it came.

3.2.11.1 *Discussion*—Retroreflectors come in a variety of forms. The retroreflector commonly used in OP/FT-IR monitoring uses reflection from three mutually perpendicular surfaces. This kind of retroreflector is usually called a cube-corner retroreflector.

3.2.12 *single-beam spectrum, n*—the radiant power measured by the instrument detector as a function of frequency.

3.2.12.1 *Discussion*—In FT-IR absorption spectrometry the single-beam spectrum is obtained after a fast Fourier transform of the interferogram.

3.2.13 *synthetic background spectrum, n*—a background spectrum made by choosing points along the envelope of a single-beam spectrum and fitting a series of short, straight lines or a polynomial function to the chosen data points to simulate the instrument response in the absence of absorbing gases or vapors.

---

[1] This guide is under the jurisdiction of ASTM Committee E13 on Molecular Spectroscopy and is the direct responsibility of Subcommittee E13.03 on Infrared Spectroscopy.

Current edition approved March 10, 1997. Published July 1997.

[2] *Annual Book of ASTM Standards*, Vol 03.06.

[3] The boldface numbers in parentheses refer to a list of references at the end of this guide.

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Where – locate leakage source accurately

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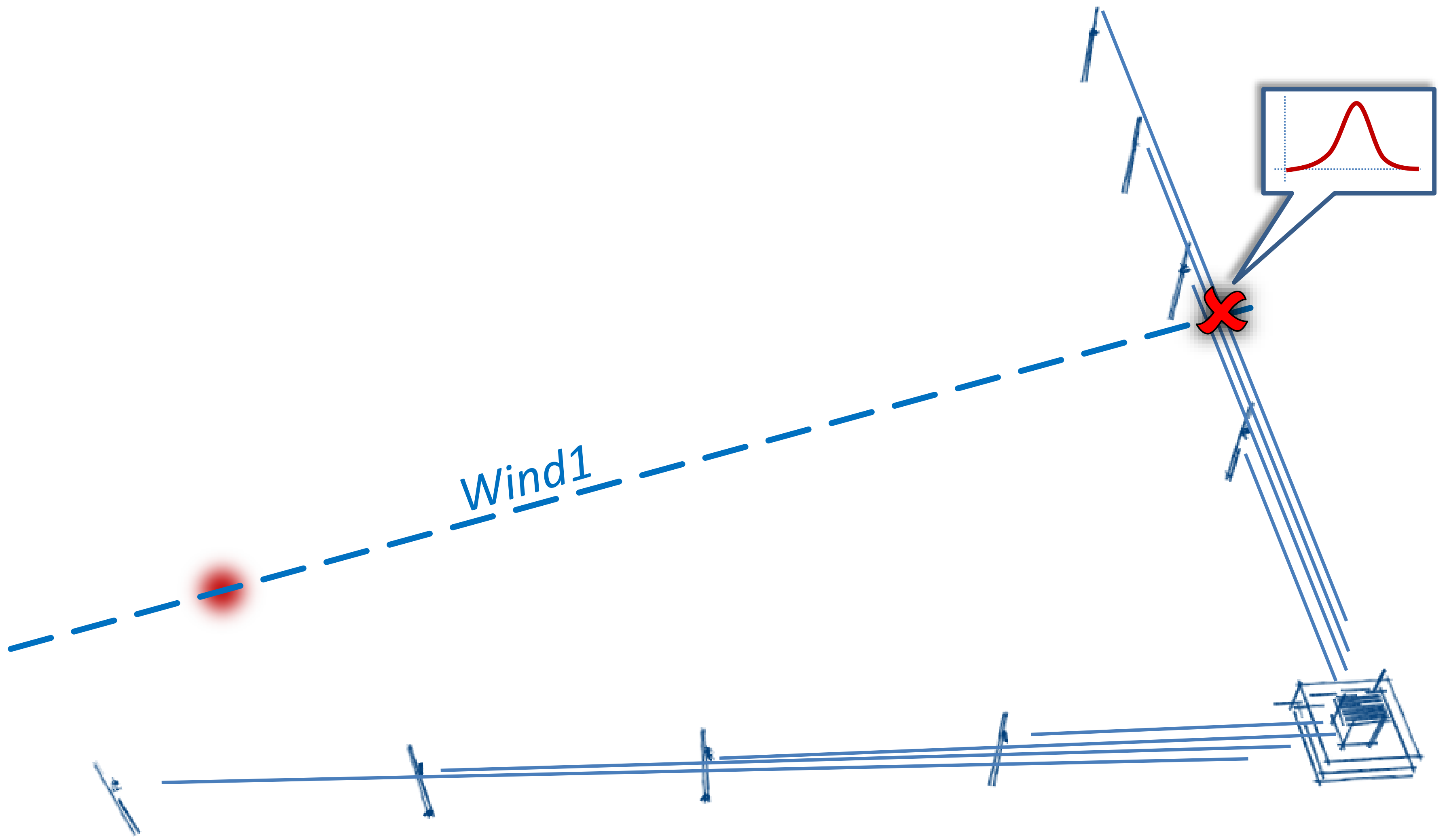

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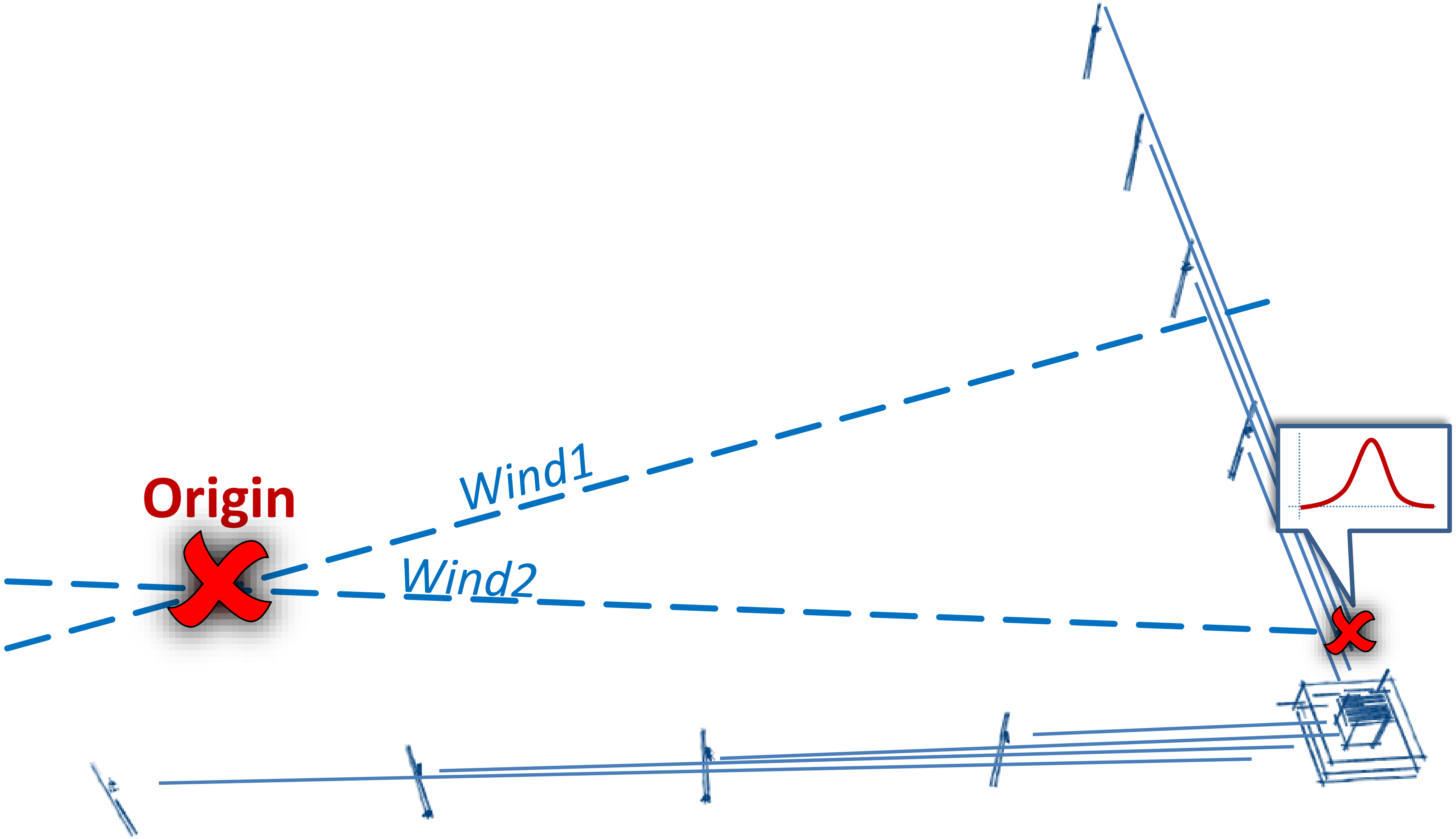
Where – locate leakage source accurately



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OTM-10 Method

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FINAL ORS Protocol
June 14, 2006

Optical Remote Sensing for Emission Characterization from Non-point Sources

1.0 Scope and Application

1.1 *Introduction.* This protocol provides the user with methodologies for characterizing gaseous emissions from non-point pollutant sources. These methodologies use an open-path, Path-Integrated Optical Remote Sensing (PI-ORS) system in multiple beam configurations to directly identify "hot spots" and measure emission fluxes. Basic knowledge of a PI-ORS system and the ability to obtain quality path-integrated concentration (PIC) data is assumed. The user must be capable of using commercial software to utilize the procedures and algorithms explained in this protocol. The methodologies in this protocol have been well developed, evaluated, demonstrated, validated, and peer-reviewed.[1-12]

NOTE 1 — Any mention of a "PI-ORS system" in this protocol refers to the open-path PI-ORS instrument itself, as well as any associated components used, such as mirrors, scanners, and software.

This protocol does not discuss specific applications (e.g., hog farms, landfills), but provides general guidelines or procedures that can be applied. Detailed protocols for specific applications may be added at a future date.

1.1.1 *Scope.* This protocol currently describes three methodologies, each for a specific use. The Horizontal Radial Plume Mapping (HRPM) methodology was designed to map pollutant concentrations in a horizontal plane. The Vertical Radial Plume Mapping (VRPM) methodology was designed to measure mass flux of pollutants through a vertical plane, downwind from an emission source. The one-dimensional Radial Plume Mapping methodology (1D-RPM) was designed to profile pollutant concentrations along a line-of-sight (e.g., along an industrial site fenceline). In future revisions to this protocol, additional PI-ORS emission monitoring methodologies (other than the methodologies described in this protocol) that address non-point sources can be added as validation data are generated.

1.1.2 *Choice of Instrumentation.* The choice of PI-ORS system to be used for the collection of measurement data (and subsequent calculation of PIC) is left to the discretion of the user, and should be dependent on the compounds of interest and the purpose of the study. The methodologies are independent of the particular PI-ORS system used to generate the PIC data. It is recommended for the HRPM, VRPM, and 1D-RPM methodologies that the typical expected concentration over the longer beams should be about 10 times the minimum detection limit of the instrument. When this is not the case, the user should replace nondetects with values of half the minimum detection limit (see Table A.3 in the Appendix A).

1

Technology Transfer Network
Emission Measurement Center

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EPA Home > Air & Radiation > TTNWeb - Technology Transfer Network > Emission Measureme

- Recent Additions
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- Methods
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- Related Web Sites
- Instructional Material
- Upcoming Events
- Who is EMC?
- EMC Contacts
- Voluntary Superior Monitoring

Test Methods

Test methods can be divided into several categories:

- Category A: Methods Proposed or Promulgated in the FR
- Category B: Source Category Approved Alternative Methods
- Category C: Other Methods
- Category D: Historic Conditional Methods

Inte

A fundamental component of the EMC web site is to provide information regarc methods into four different categories. The categories are based on the legal s

http://www.epa.gov/ttn/emc/tmethods.html

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The Radial Plume Mapping Configurations

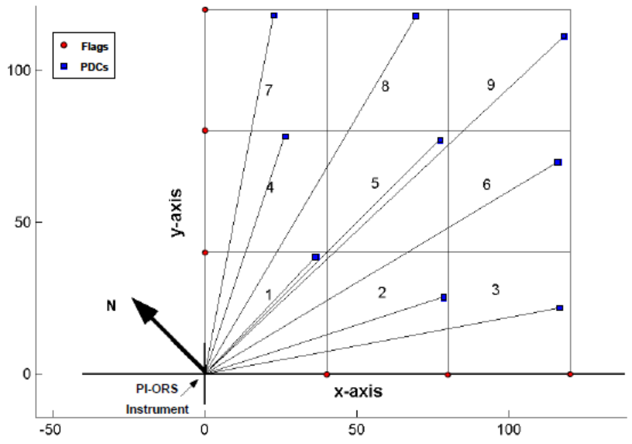

Figure 1. Example of a HRPM Configuration setup

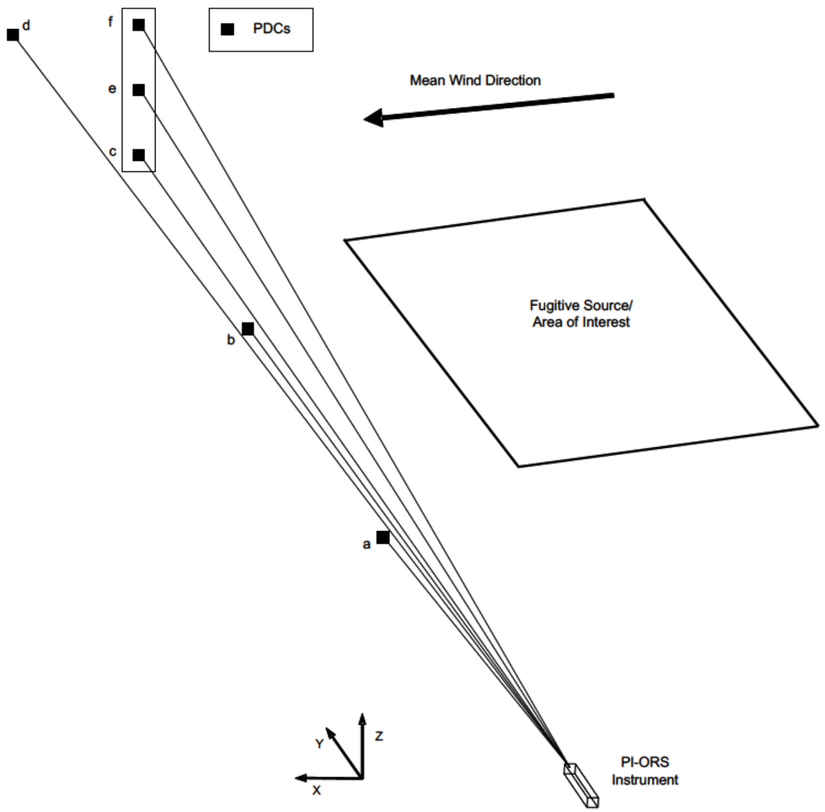

Figure 2. Example of a VRPM Configuration setup

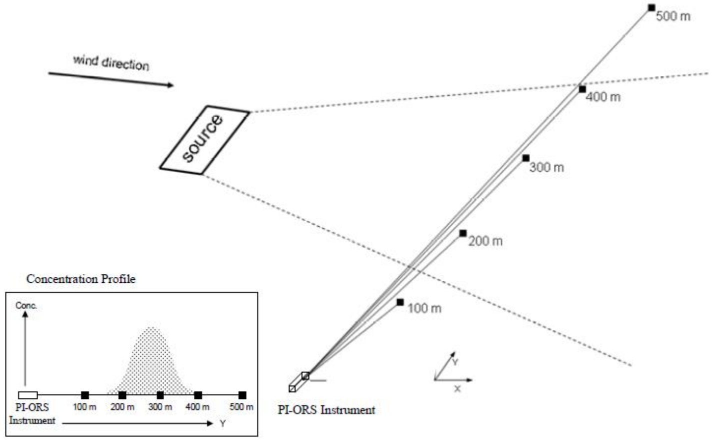

Figure 3. Example of a 1D-RPM Configuration setup

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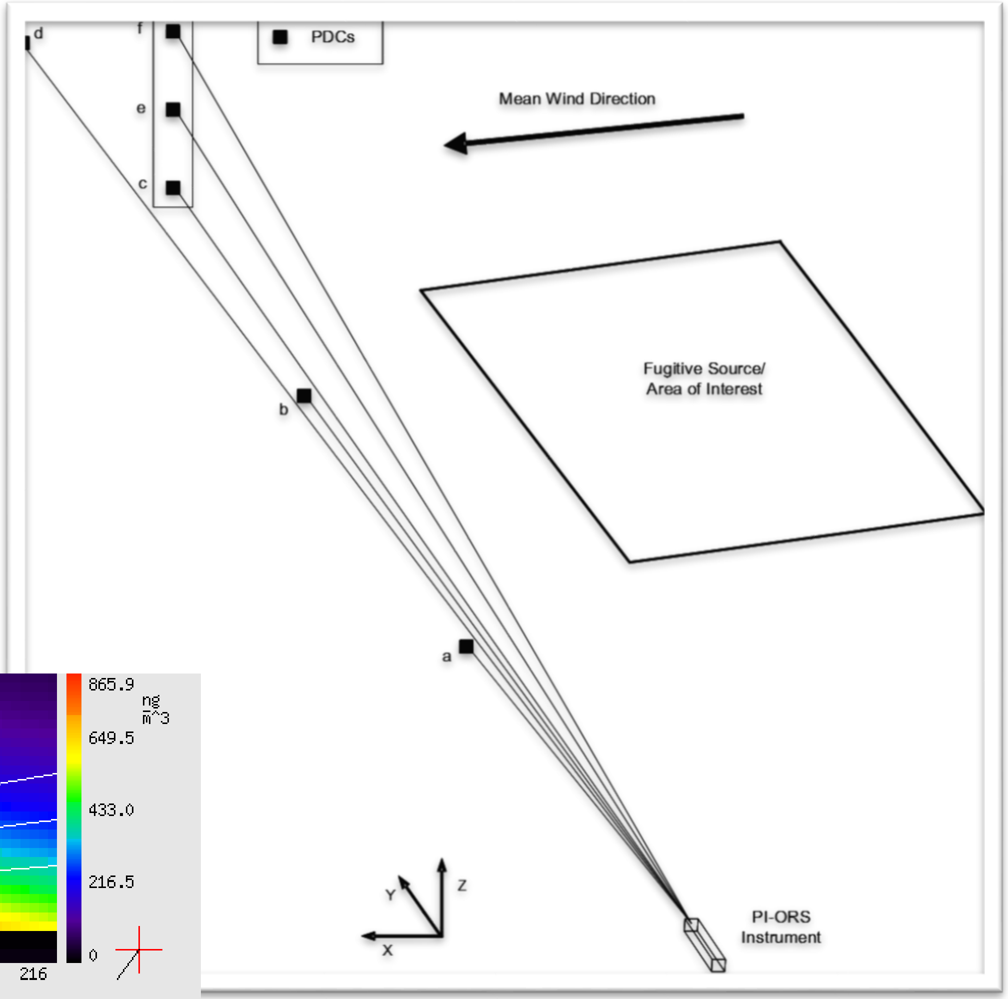
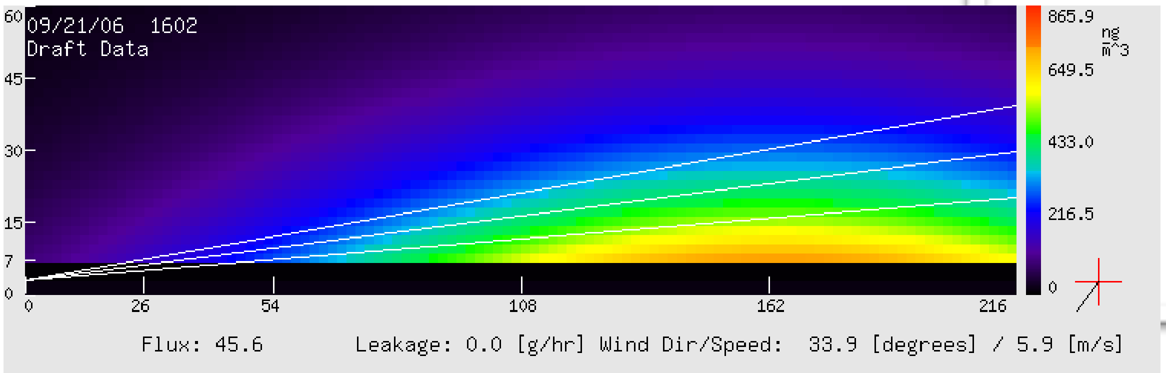
VRPM USEPA OTM-10





Atmosfir Optics - D-Fenceline solution

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- The design of the D-Fenceline system address all the core requirements:
  - **When** ?
  - **What** ?
  - **Where** ?
  - **How much ?**

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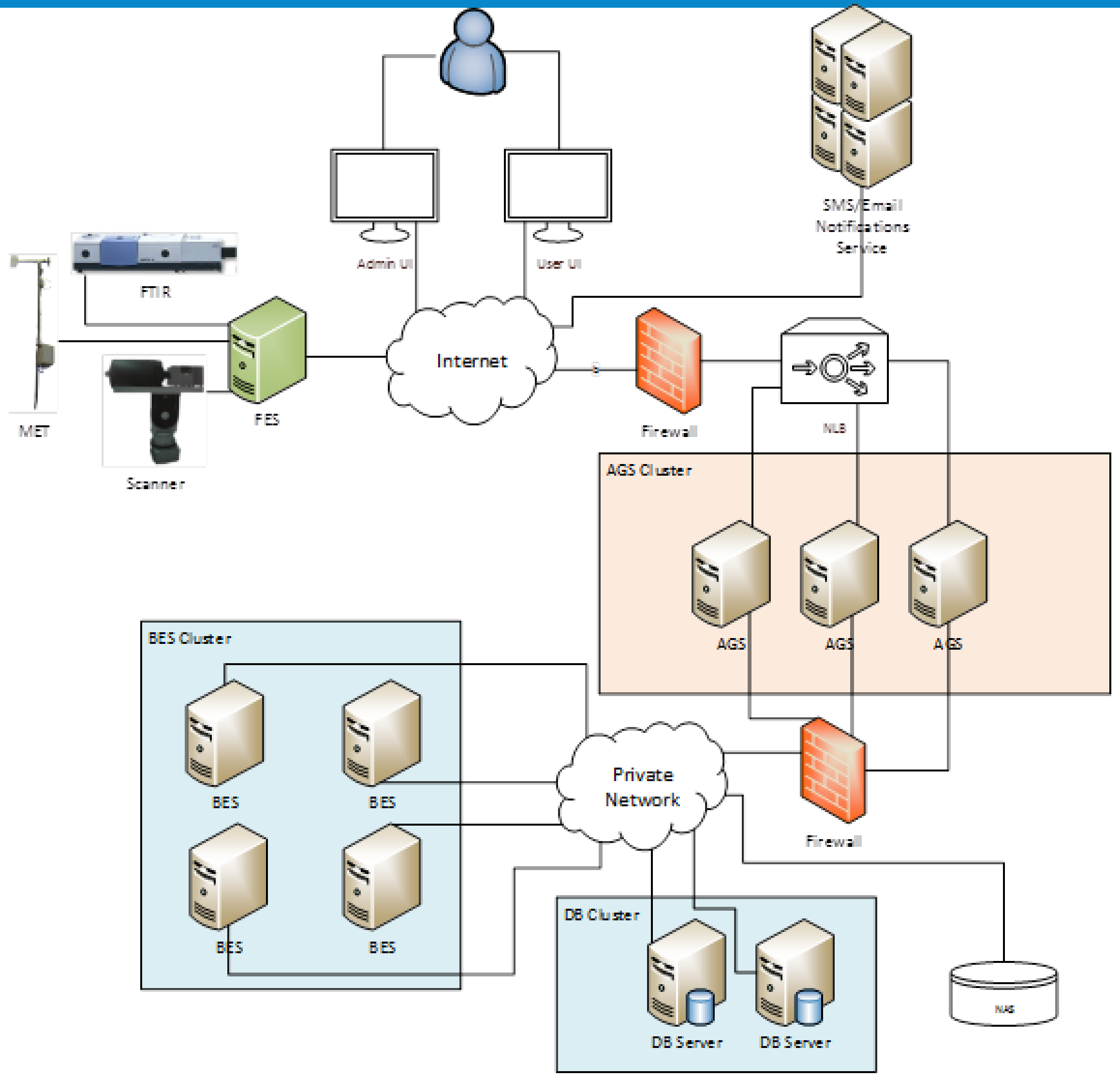
D-fenceline System Overview



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Glossary

- **FES** – Front End Server
- **MET** – Meteorology device
- **OPS** (FTIR) – Open Path System
- **BES** – Back End Server
- **AGS** – Application Gateway Server
- **DB** – Database
- **NLB** – Network Load Balancer
- **UI** – User Interface
- **AL** – Alert Level
- **MDL** – Minimum Detection Limit
- **BQL** – Below Quantification Level
- **PPB** – Parts Per Billion

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D-fenceline UI – Login Page

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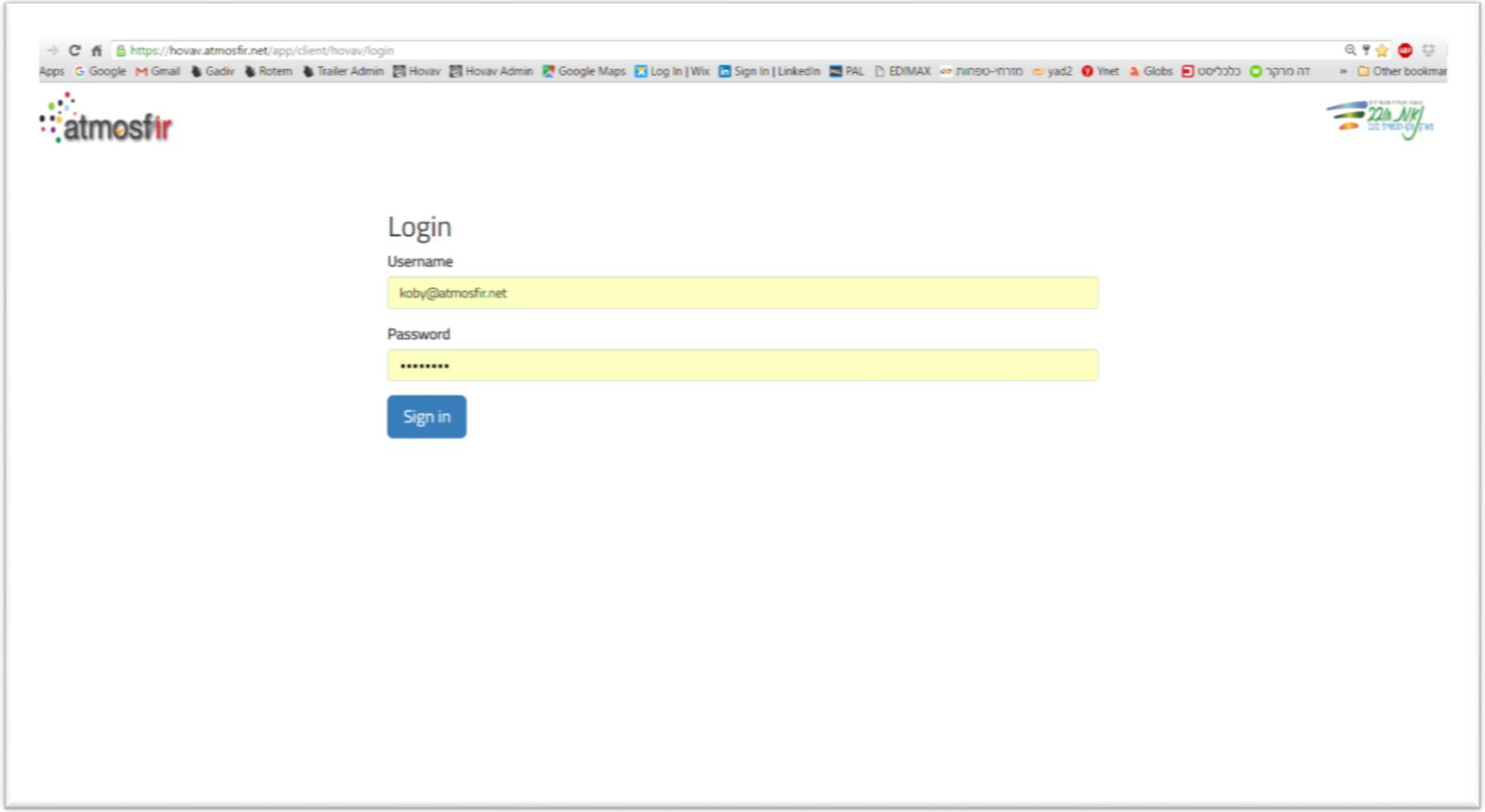
- Secured encrypted protocol, 10 Users, 1 live session for each user, force logout.



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The D-fenceline System UI

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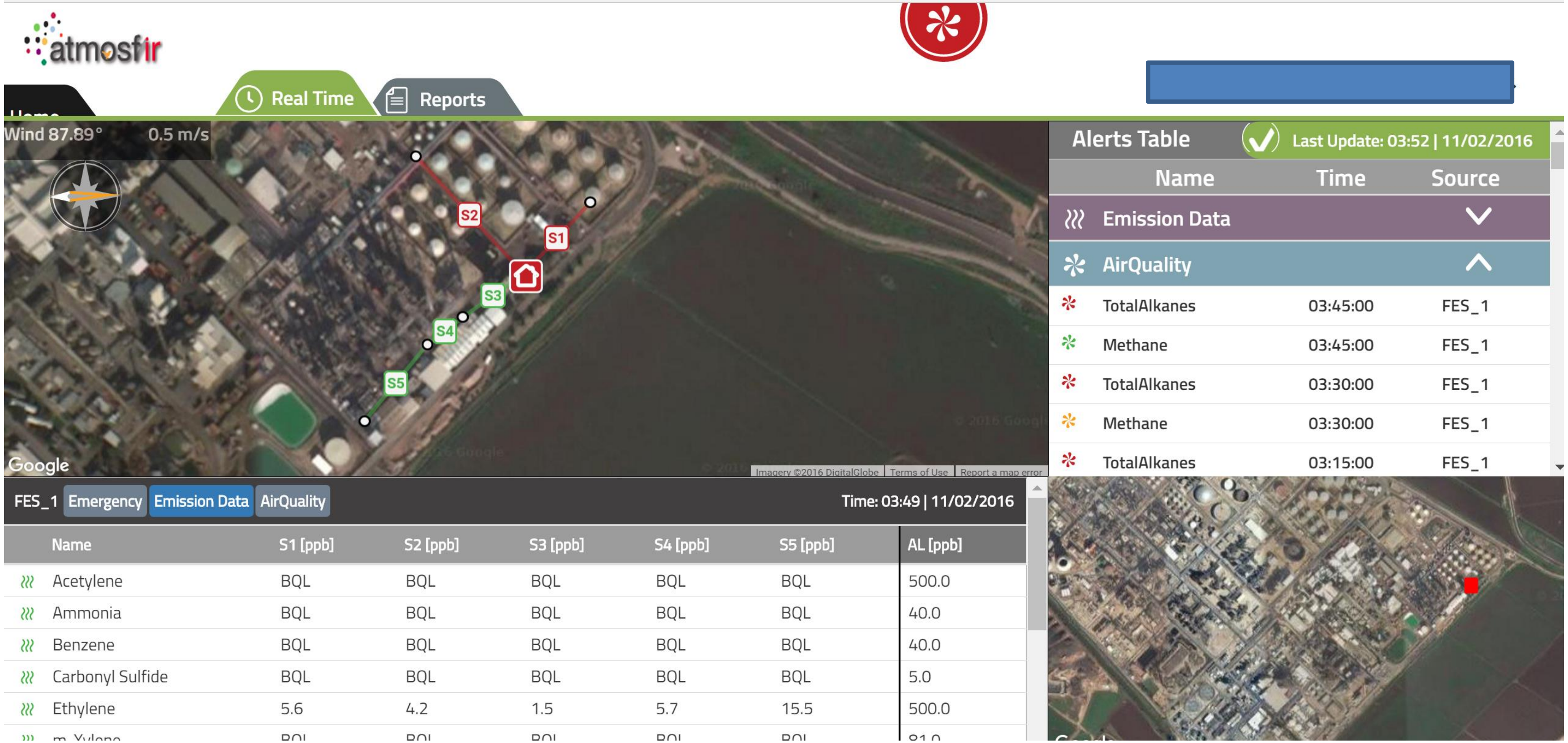

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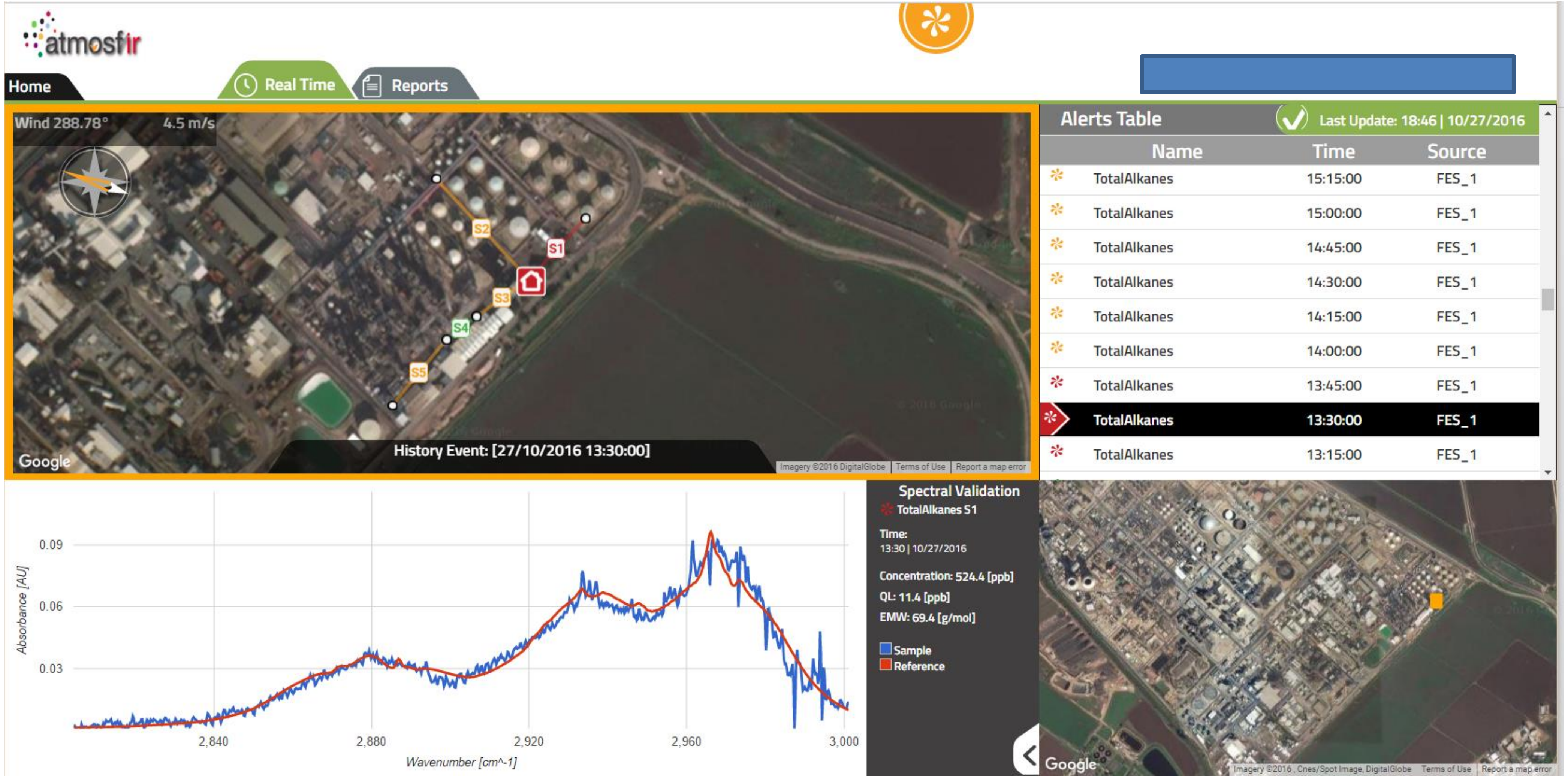
Online Spectral Validation – Live System



[Wavelength]

[Wavelength]

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Automatic Source Location

FES_1						Time: 13:15 | 09/15/2016
Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
Ammonia	BQL	BQL	BQL	14	BQL	10

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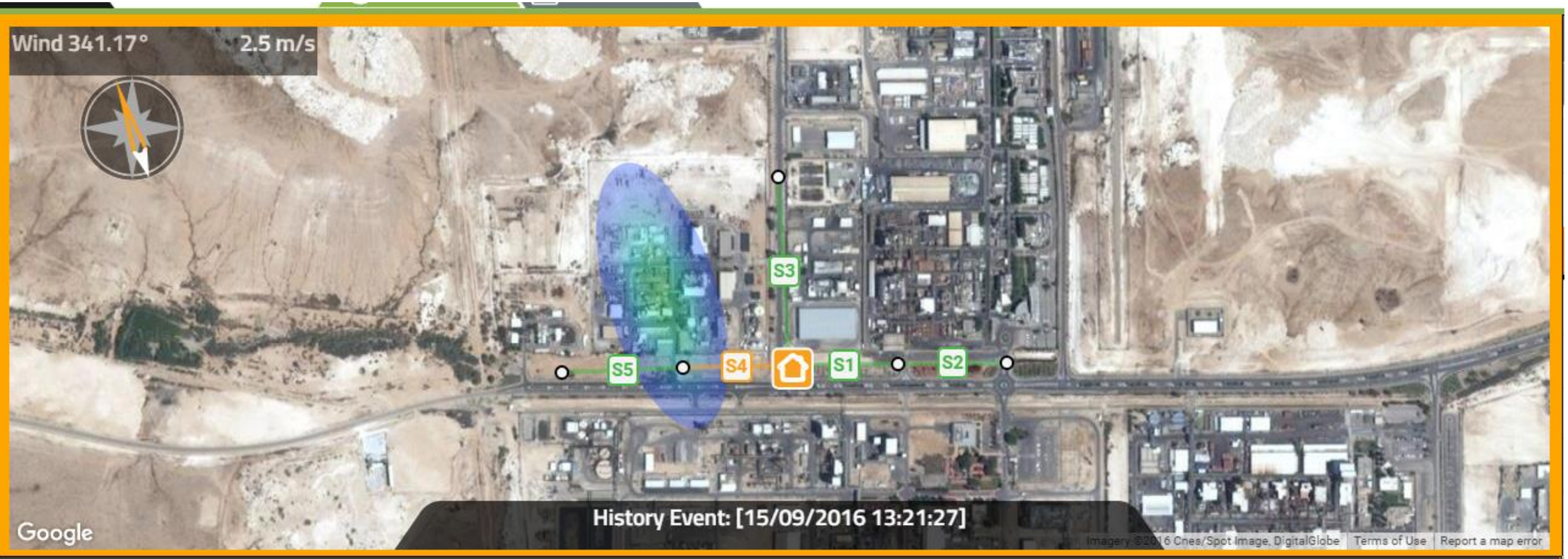
Automatic Source Location

Atmosfir Optics Ltd.



FES_1 Time: 13:21 | 09/15/2016

Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
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Automatic Source Location

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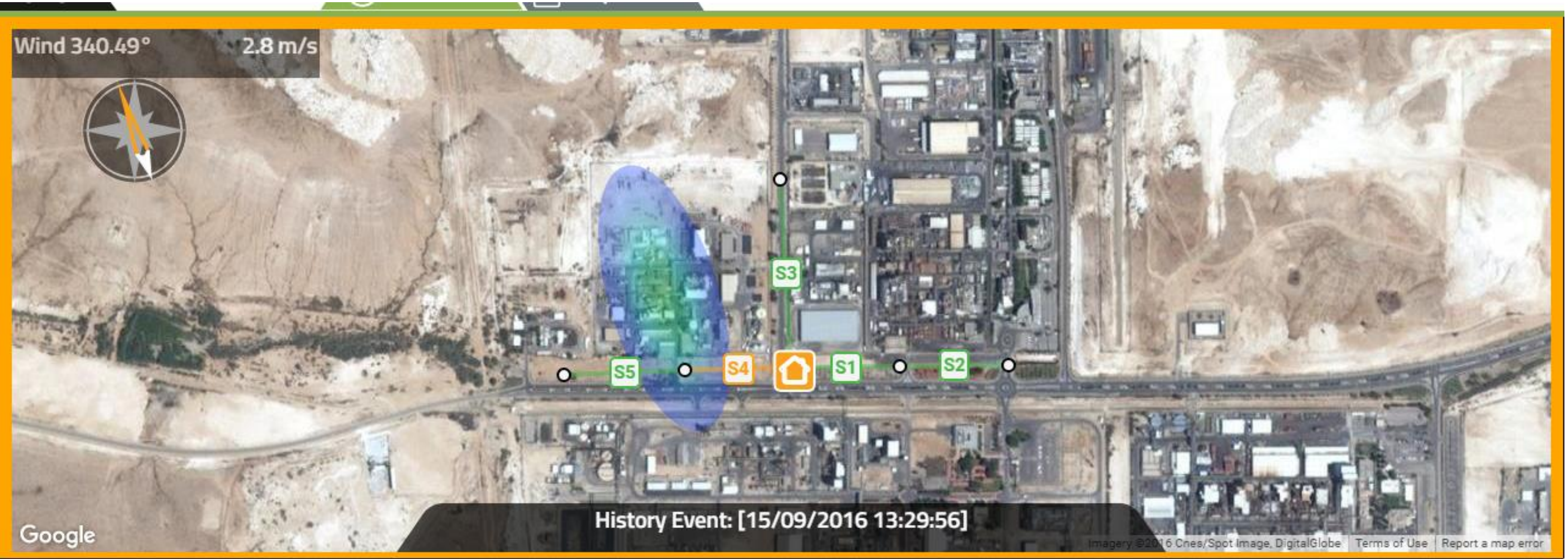

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Ammonia		BQL	BQL	16	BQL	10

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Automatic Source Location

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FES_1 — Time: 13:34 | 09/15/2016

Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
Ammonia	BQL	BQL	BQL	31	BQL	10

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Automatic Source Location

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FES_1 Time: 13:40 | 09/15/2016

Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
Ammonia	BQL	BQL	BQL	32	10	10

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Automatic Source Location

Atmosfir Optics Ltd.

FES_1 | Time: 13:45 | 09/15/2016

Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
Ammonia	BQL	BQL	BQL	29	14	10

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Automatic Source Location

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FES_1 Time: 13:51 | 09/15/2016

Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
Ammonia	BQL	BQL	BQL	27	12	10

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Automatic Source Location

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FES_1 — Time: 13:56 | 09/15/2016

Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
Ammonia	BQL	BQL	BQL	27	11	10

Quality above all

Automatic Source Location

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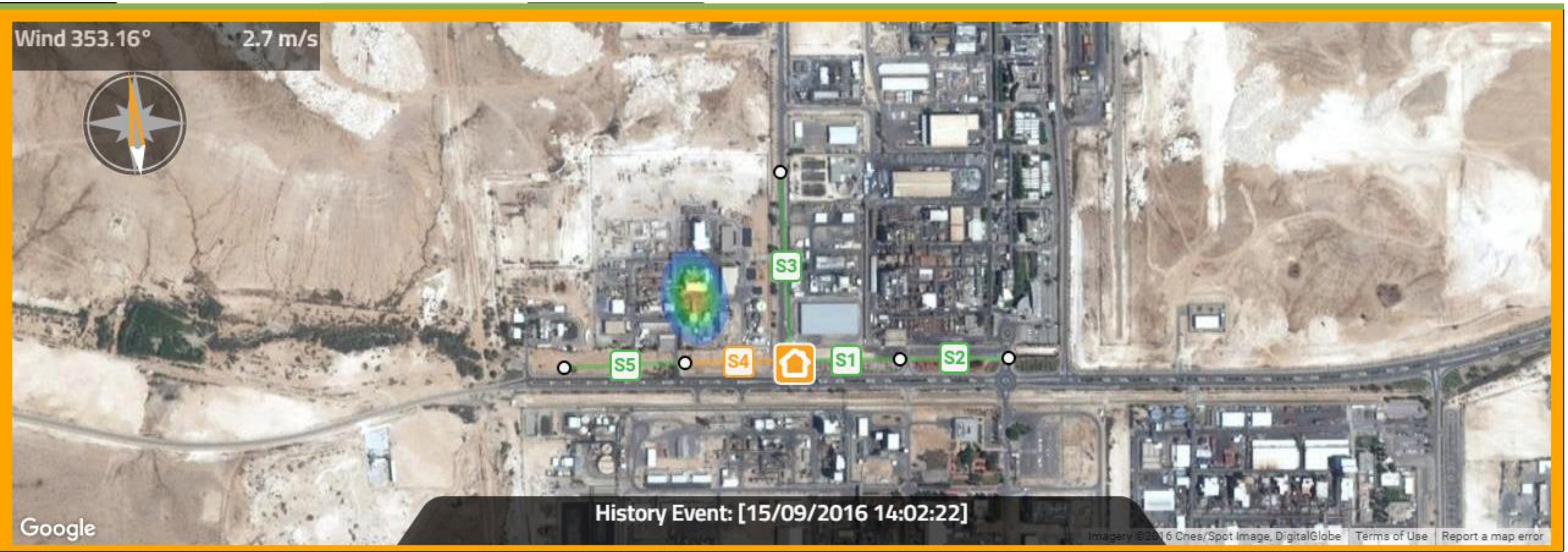

FES_1 Time: 14:02 | 09/15/2016

Name	S1 [pbb]	S2 [pbb]	S3 [pbb]	S4 [pbb]	S5 [pbb]	AL [pbb]
Ammonia	BQL	BQL	BQL	13	BQL	10

Quality above all

Reports – Benzene live system

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Pollutant & Wind Roses Live System

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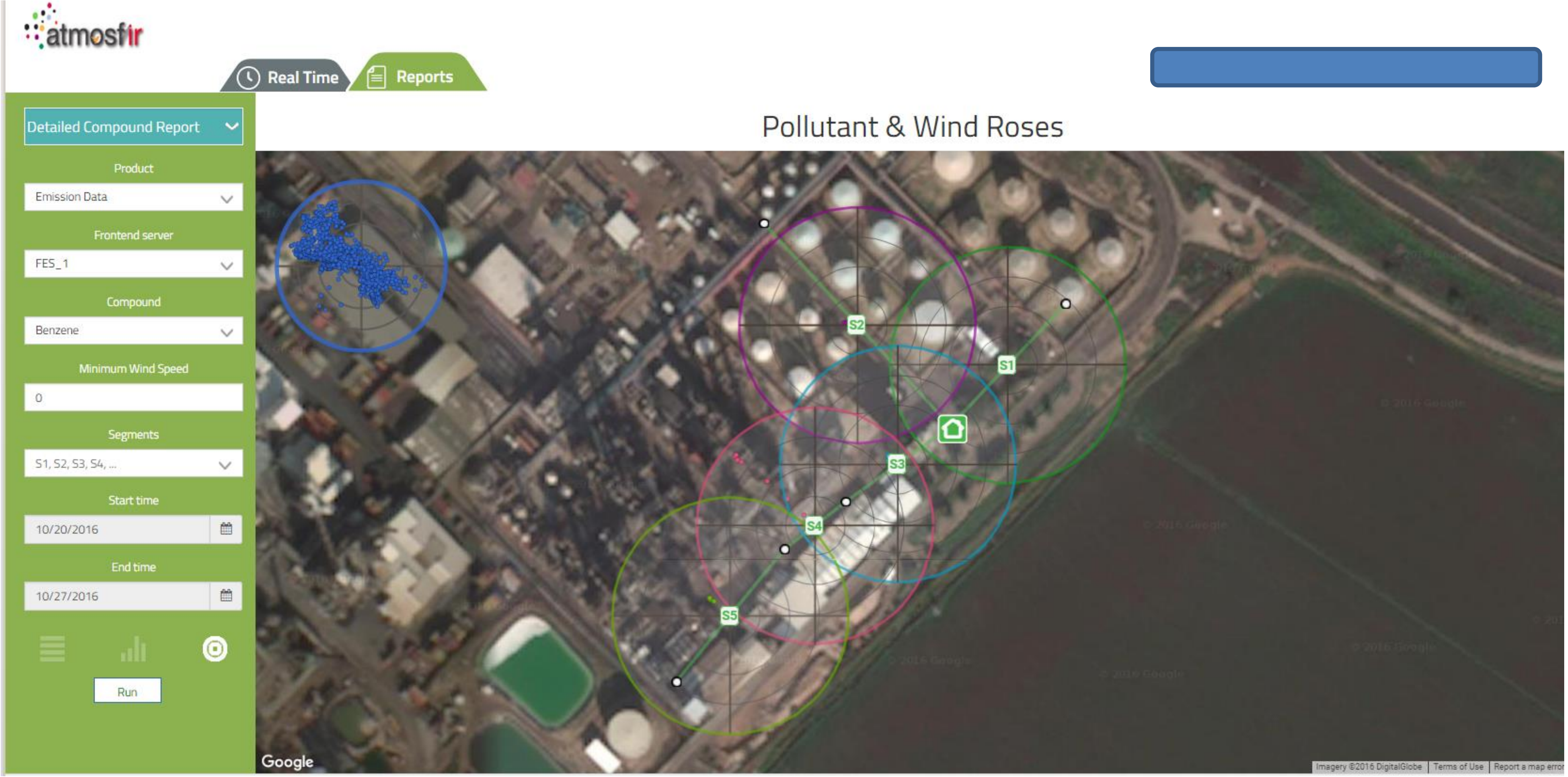

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Admin Dashboard Live System

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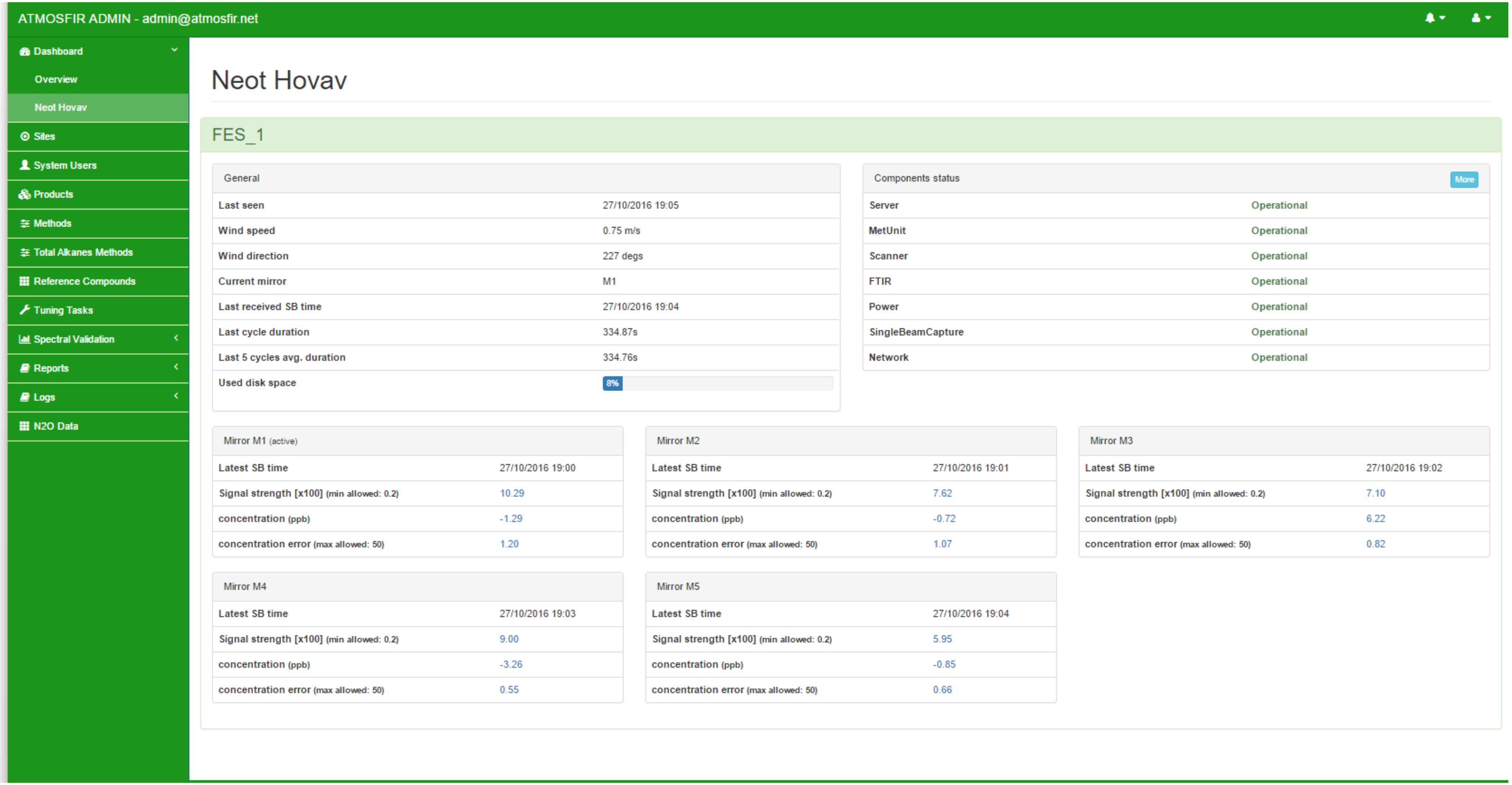

Quality above all

D-fenceline measurement systems

Efficient Monitoring for Managing your emissions

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Atmosfir Optics Major Applications

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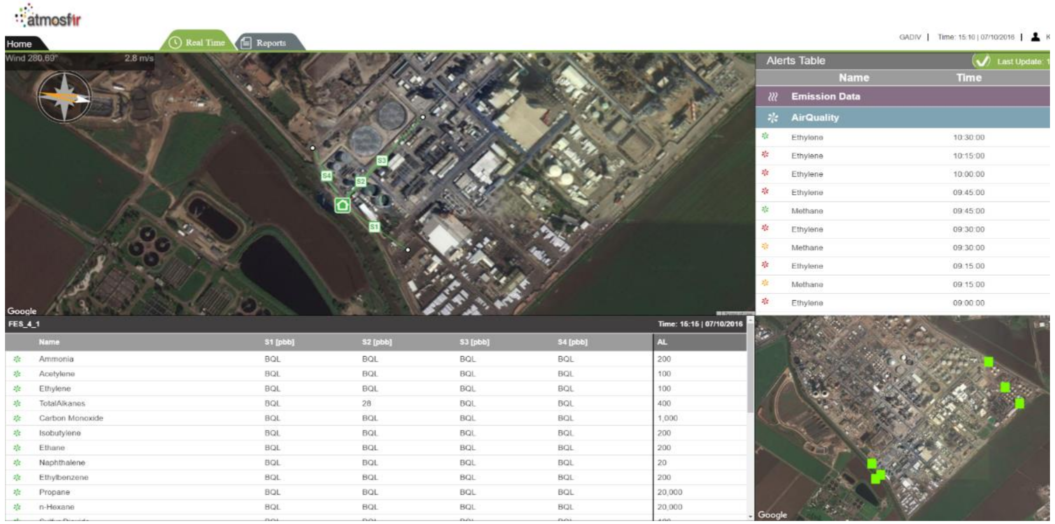

Services

- Long term fixed installation of ORS air contaminate measurement systems
- Short term ORS measurement projects
- System engineering and design

Products

- D-fenceline F- Upgraded FTIRs
- D- fenceline THC -Atmosfir propriety for remote Wise-LDAR
- D-fenceline UV - Sensors for wide area monitoring via Open Path of Cl_2, NH_3, CH_4, H_2S, HF, and aromatics

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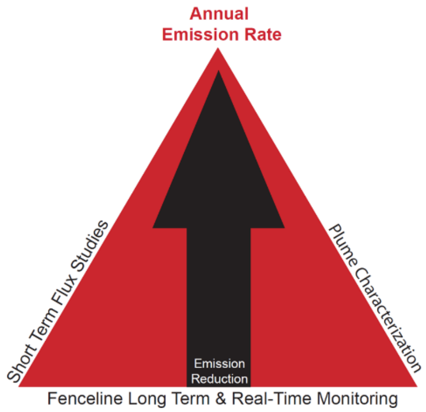
Annual Emission Rate

- Detailed short term emission flux studies at fenceline continuous monitoring sites

- Detailed composition profiling specifically to a fenceline continuous monitoring site

- Data correlation between short term and continuous allows an accurate estimate of annual emission rate



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Potential clients – by industry

- Petrochemical & Refinery
- Chemical plants – fertilizers, plastic, acid, semiconductor, pharmaceutical, hazarded treatment plants
- Land fields
- Water treatment plant
- Chemical terminals
- Evaporation polls

Quality above all

Potential clients – compounds

- Odor – amines , mercaptans, alcohols …
- Hazardous material- phosgene, benzene, Carbon tetrachloride…
- Acids – HCl ,HBr, HF SIF_4 …
- Aldehydes – formaldehyde , acetaldehyde , benzaldehyde …
- GHGs – Methane, N_2O , CO_2…

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Phosphate plant and evaporation polls

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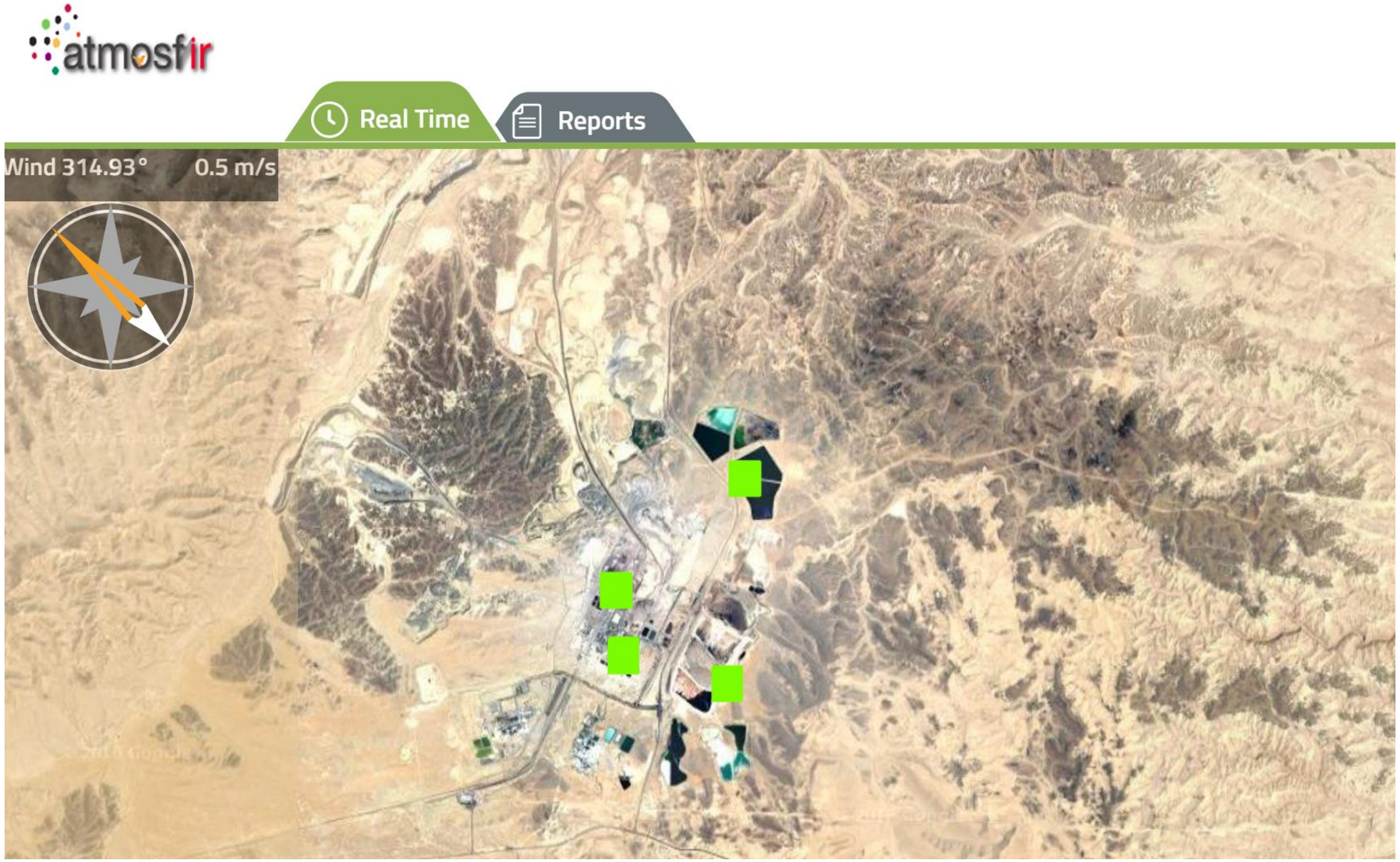

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Examples of OP FTIR Projects in ISRAEL

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More projects Israel & Taiwan

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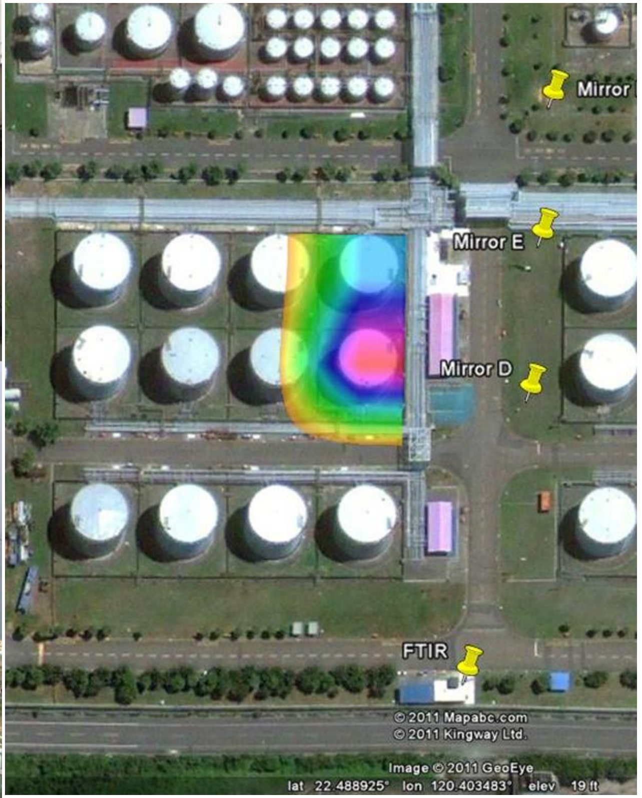

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South Coast Air Quality Management District
AQMD
Cleaning the air that we breathe...

USA California EPA

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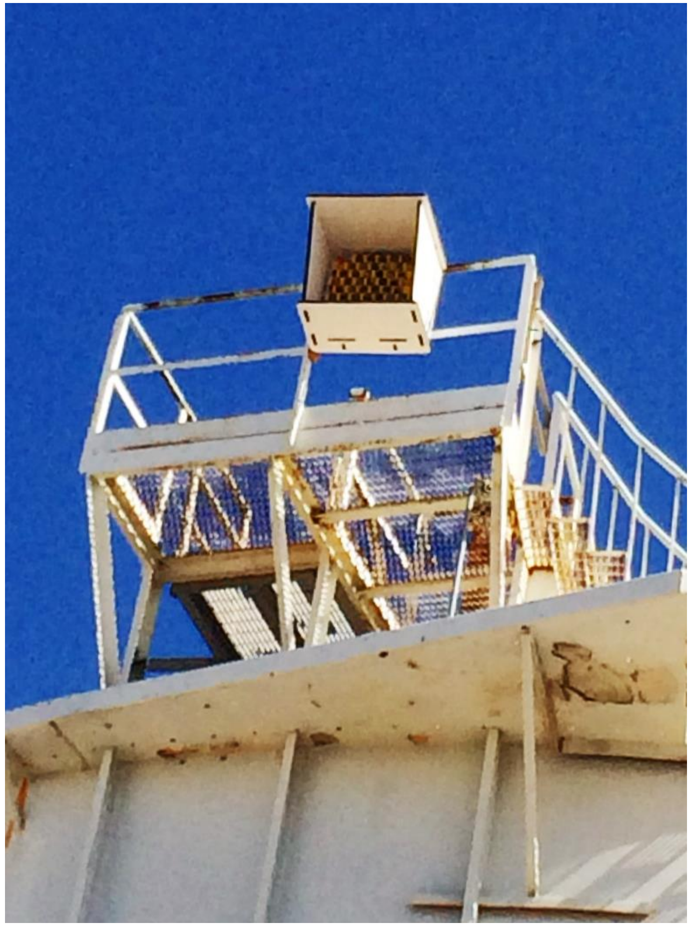
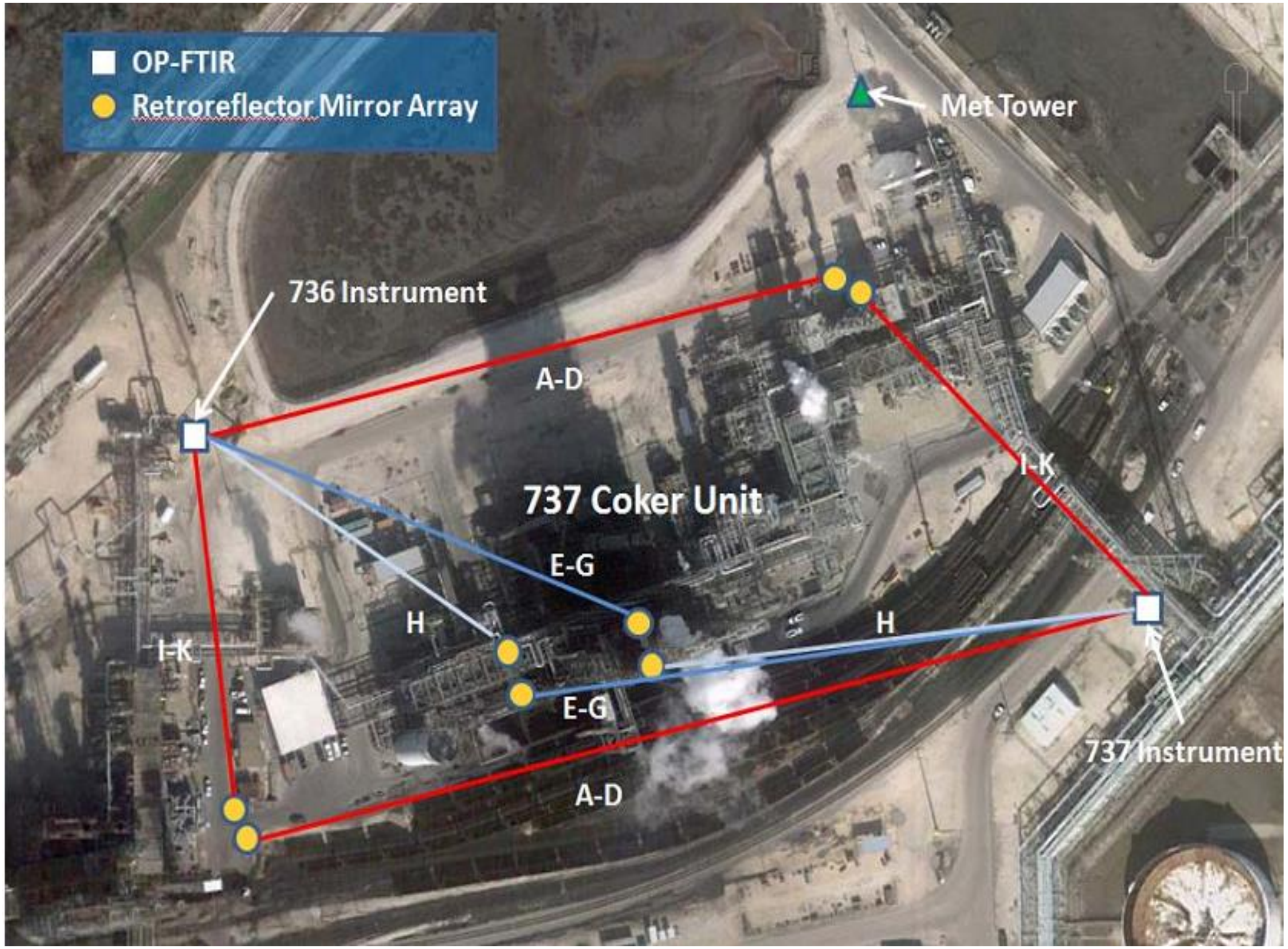
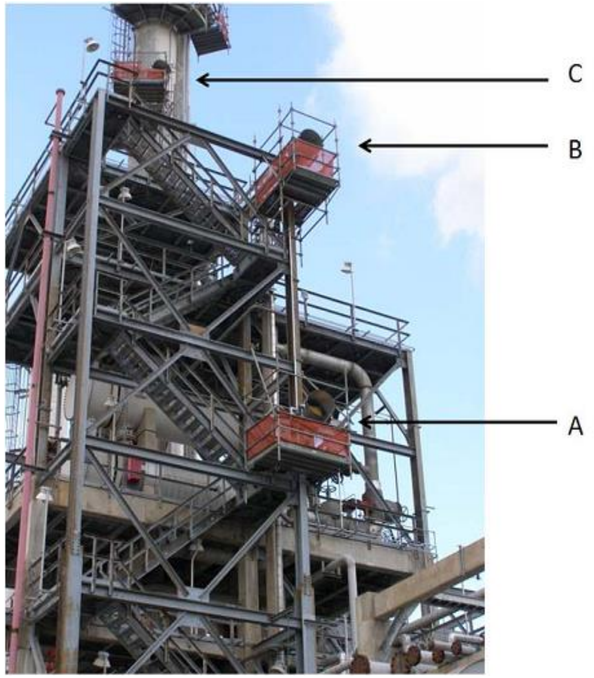


ality above all

Houston Refining USA TX





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More Projects "Oil Sands" Canada , Chemical manufacture in Australia

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Flares "Combustion Efficiency"

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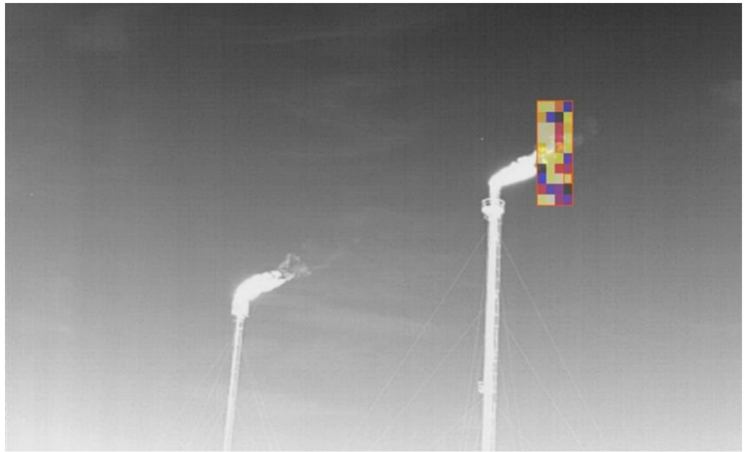

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Thank You!

Questions ?

gilad@Atmosfir.net