
EPA's Continued Development and Application of Optical Remote Sensing (ORS) for Emission Monitoring

D. Bruce Harris, Chester A. Vogel, Richard C. Shores, and Edgar L. Thompson

U.S. Environmental Protection Agency

National Risk Management Research Laboratory
Research Triangle Park, NC 27711

Ram A. Hashmonay, Keith Wagoner, and David F. Natschke

ARCADIS

4915 Prospectus Drive, Suite F
Durham, NC 27713

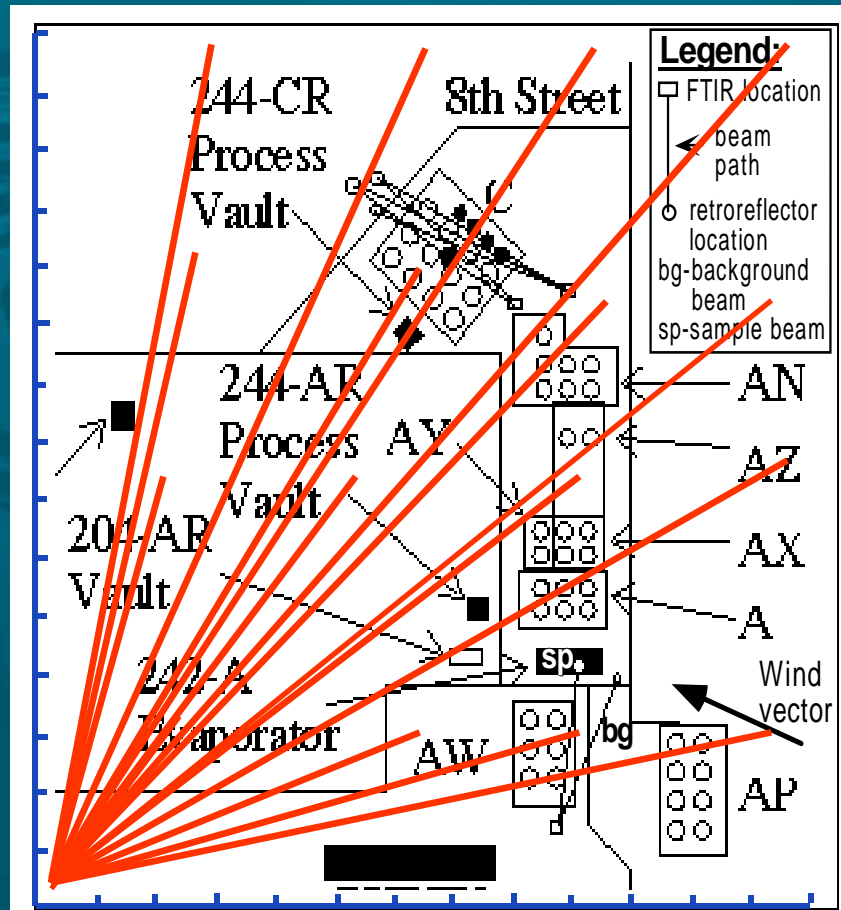
July 29-31, 2002

Recent Activities -- ORS Method Development

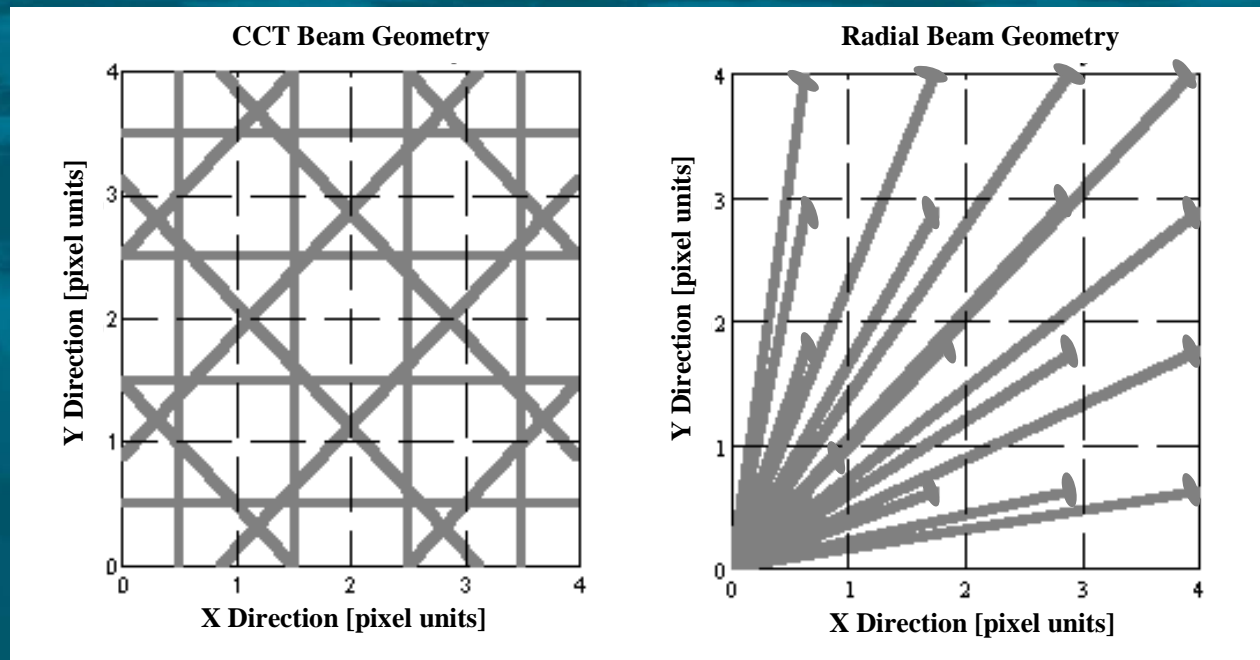
- Radial scanning to locate emission sources
 - Small-scale field test using simulated source to test capability
 - Small field study on actual source site
- Diesel exhaust plume sampling

Radial Scanning

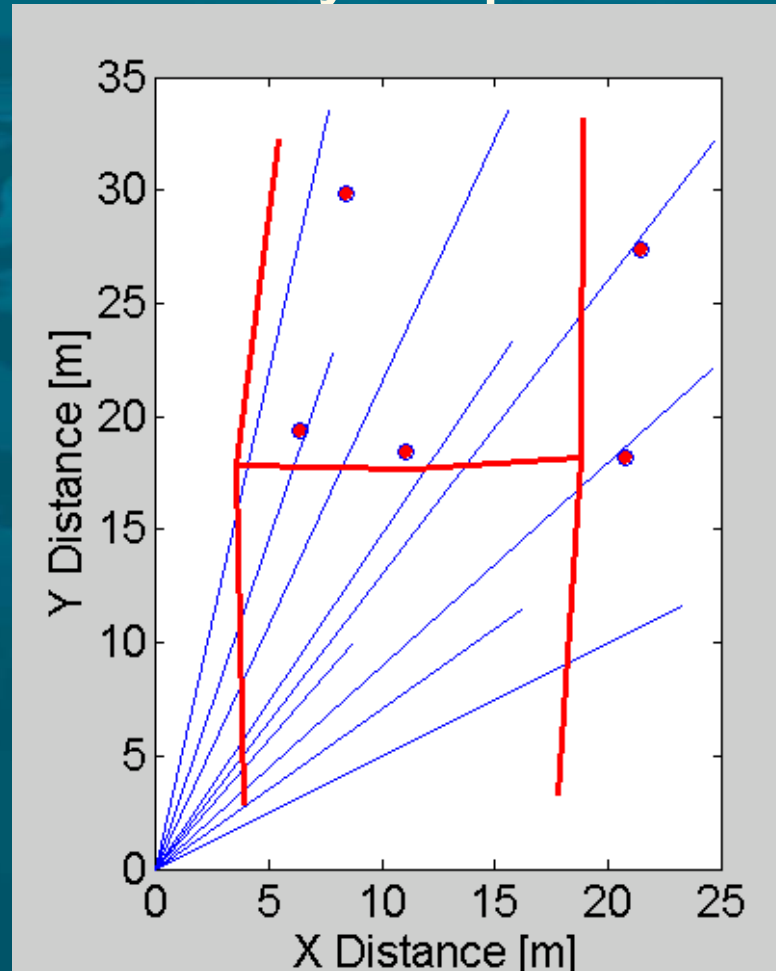
Radial Geometry: A Simplified Practical Approach



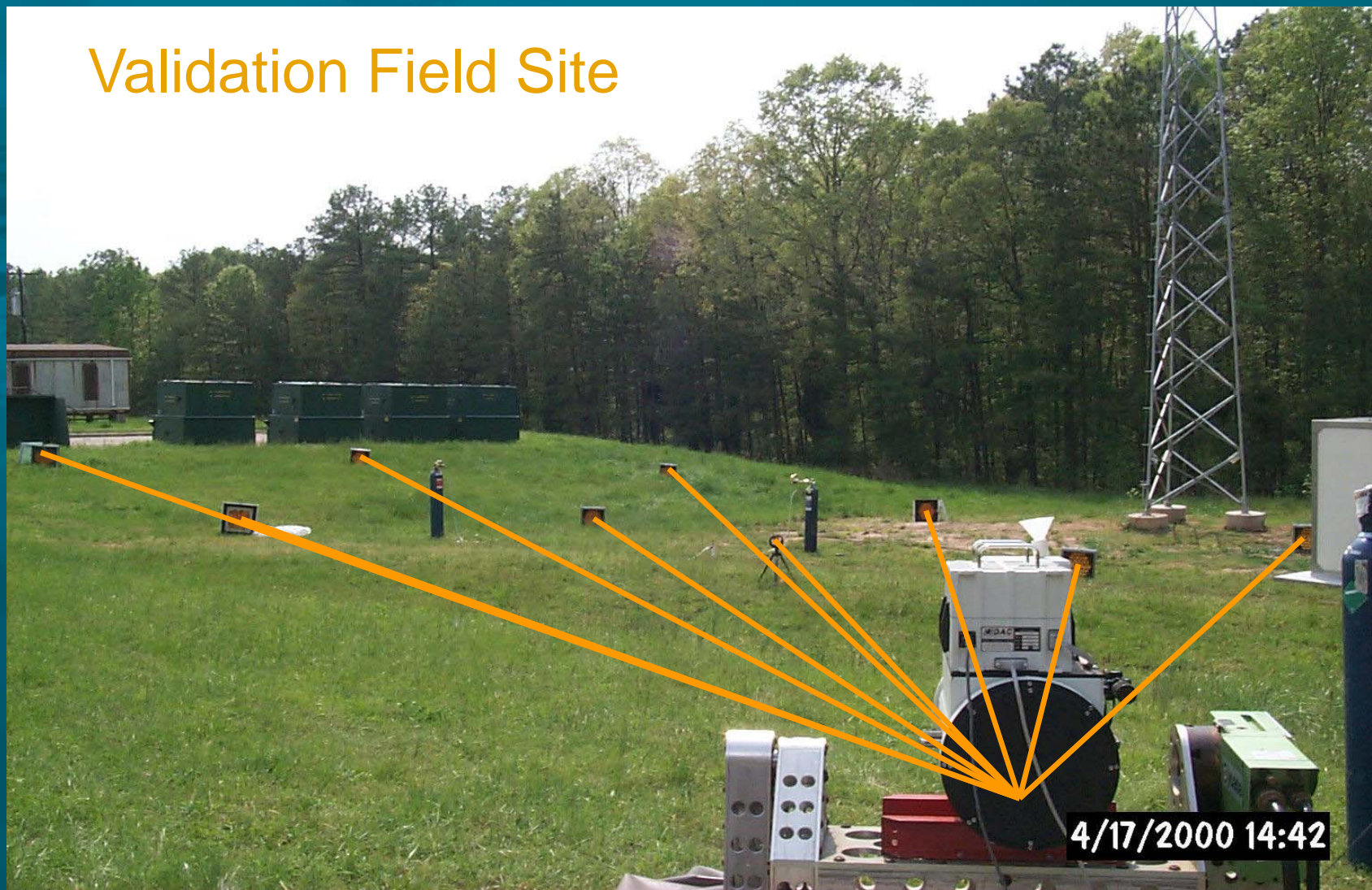
16-Beam Classical CT and Radial CT Configurations



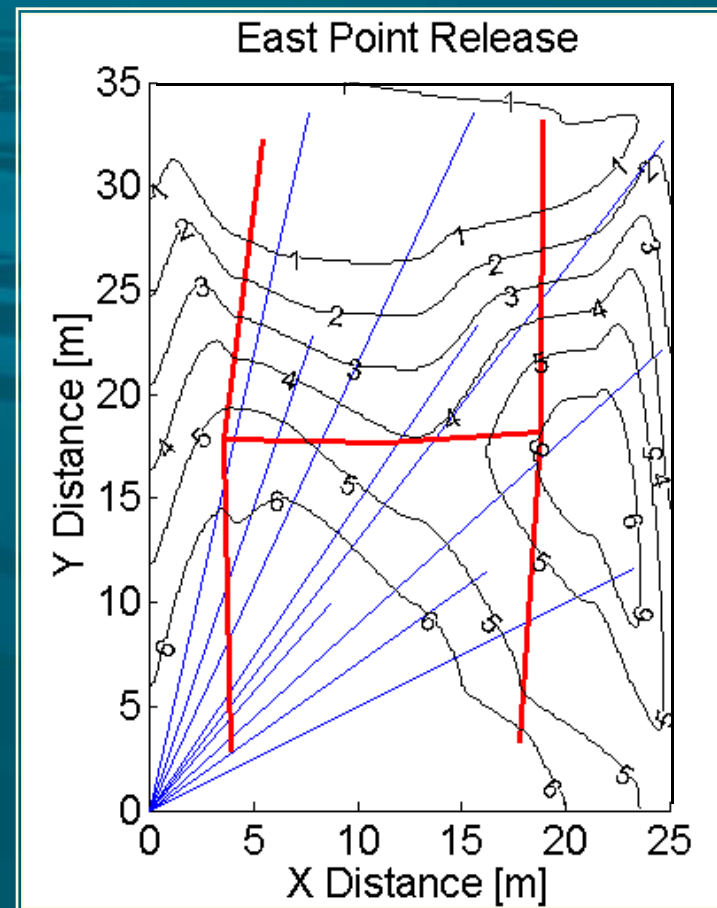
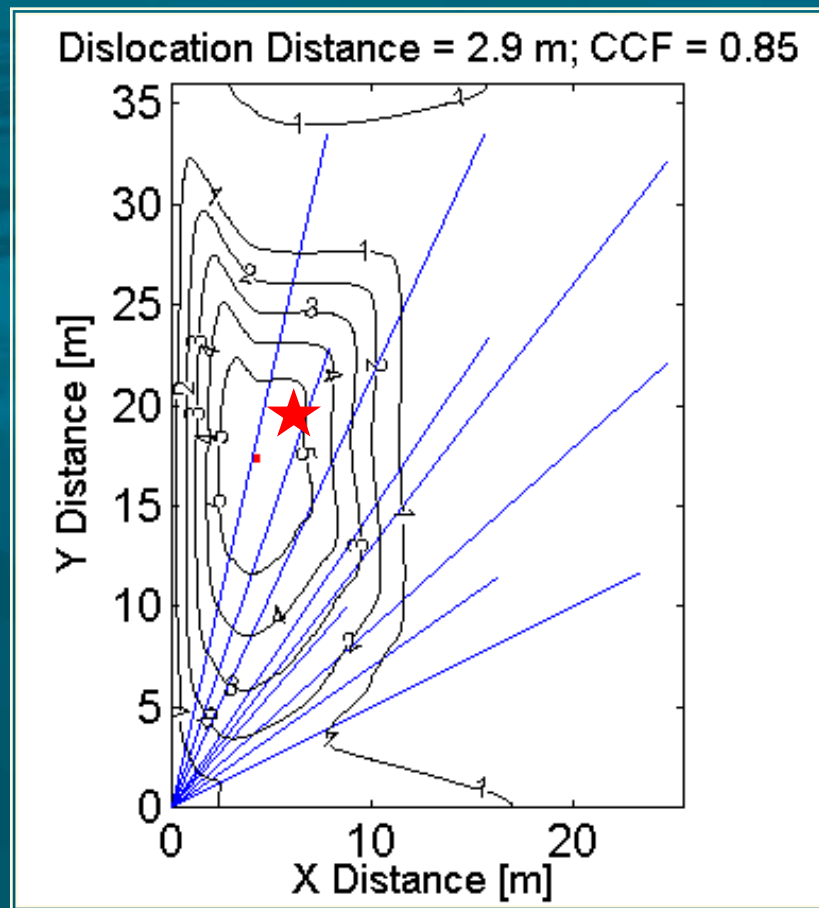
Validation Study Experimental Setup



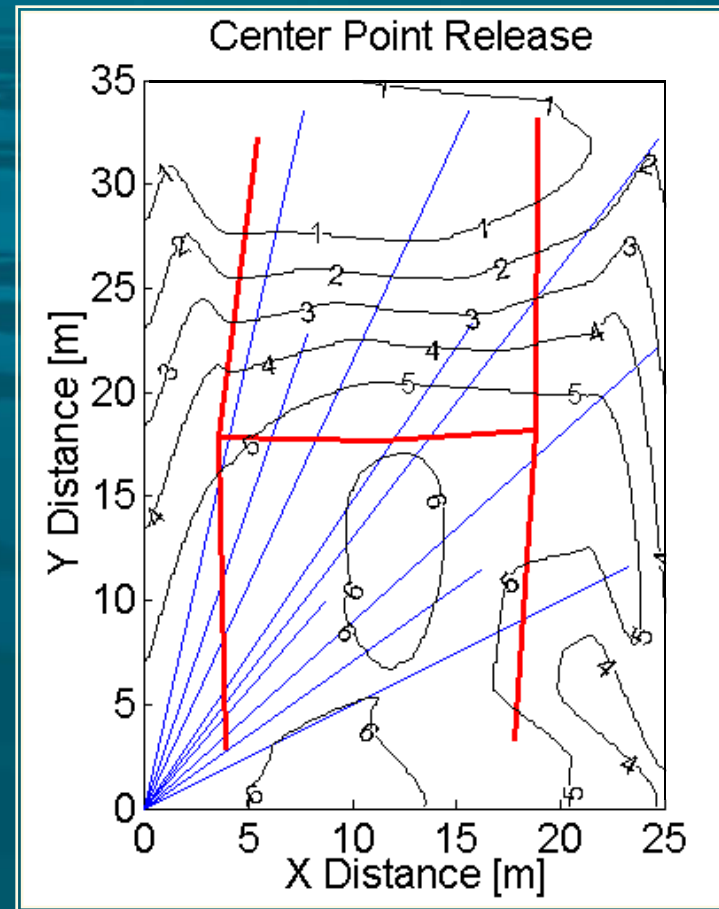
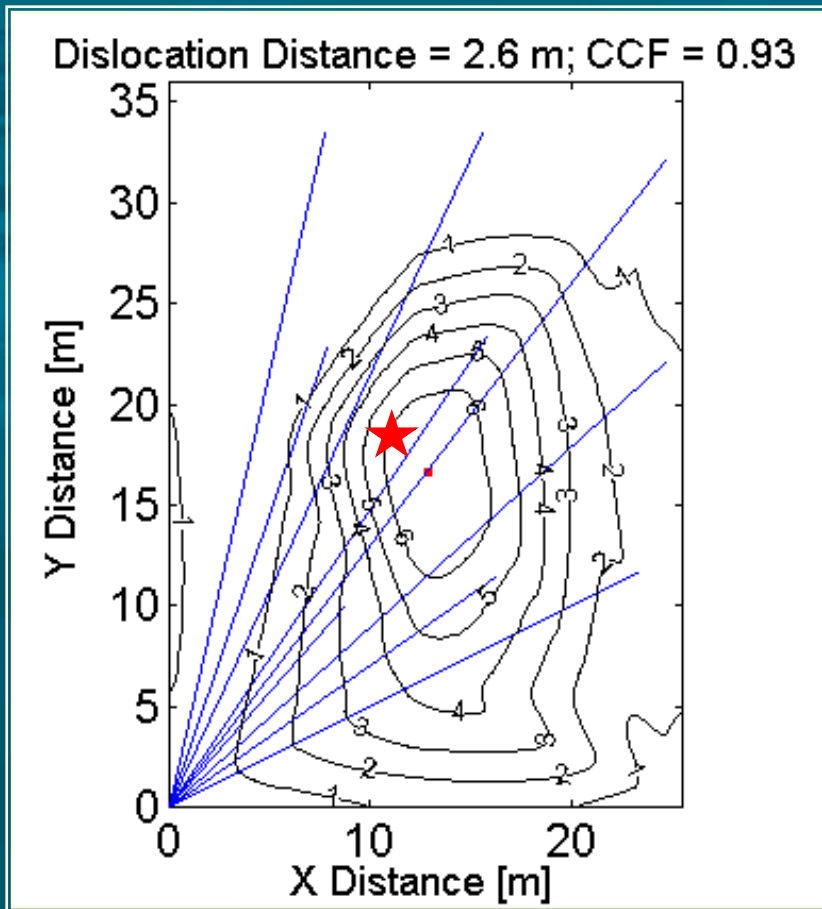
Validation Field Site



East

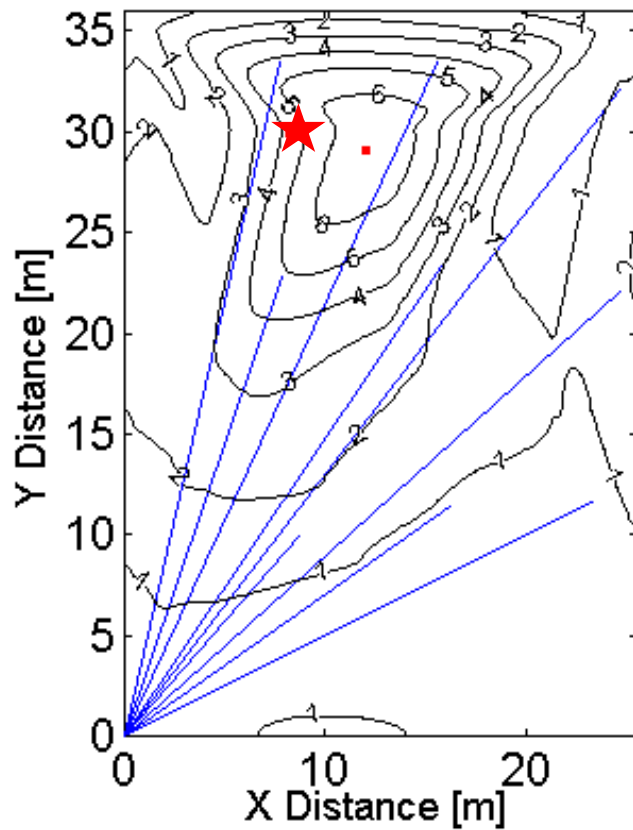


Center

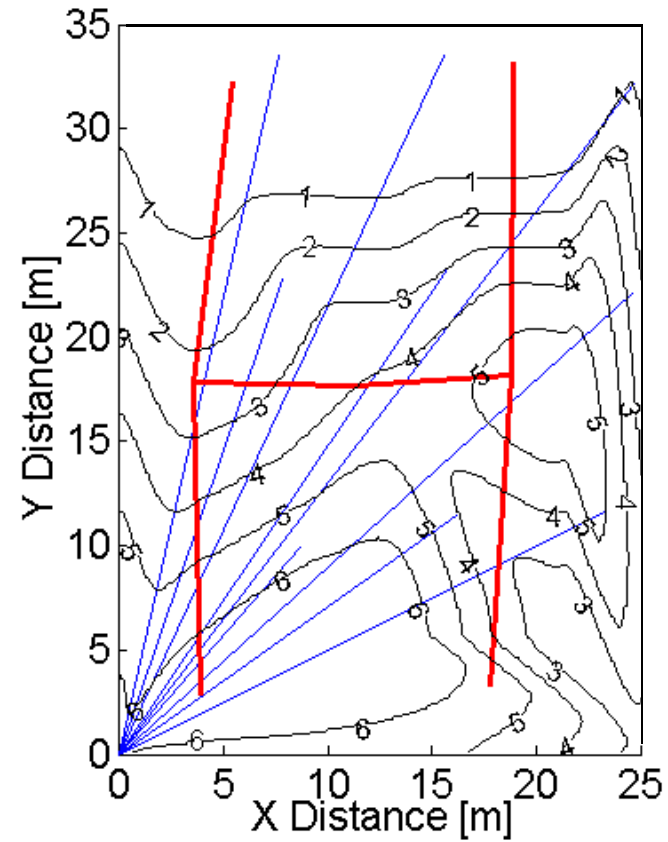


South

Dislocation Distance = 3.8 m; CCF = 1.0

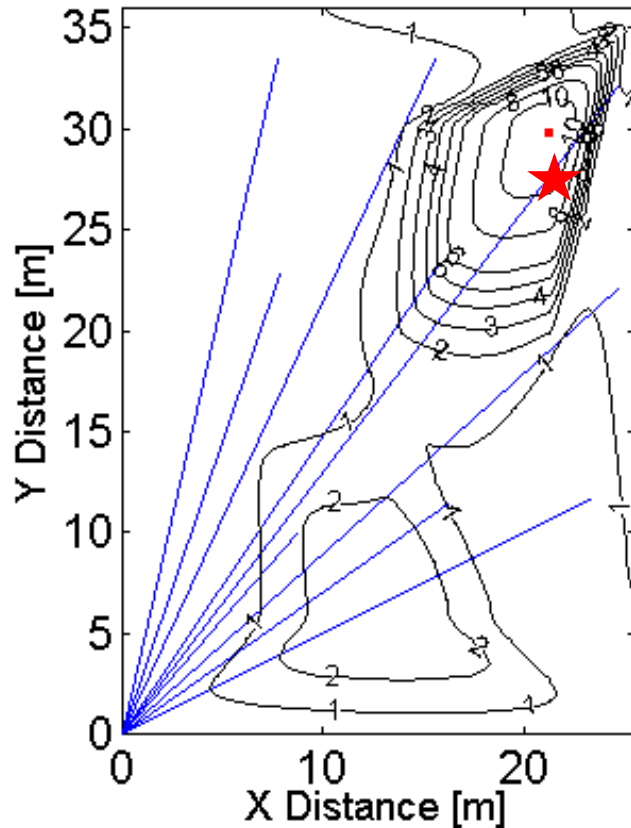


South Point Release

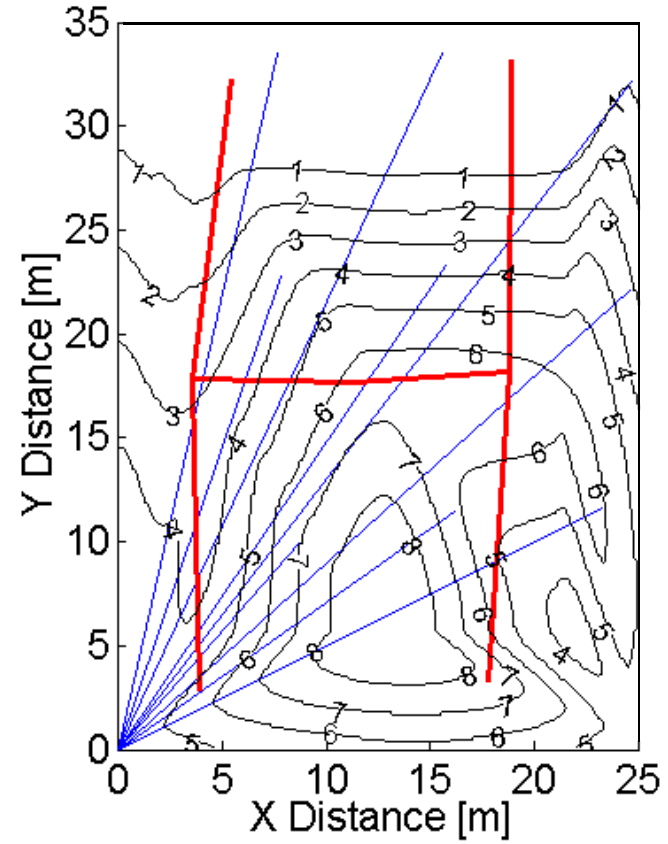


Southwest

Dislocation Distance = 2.4 m; CCF = 1.0

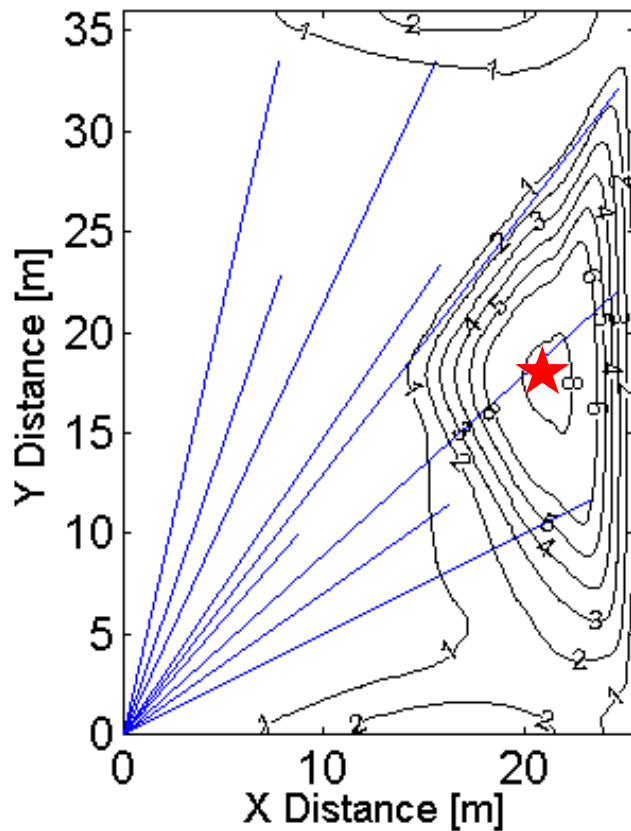


Southwest Point Release

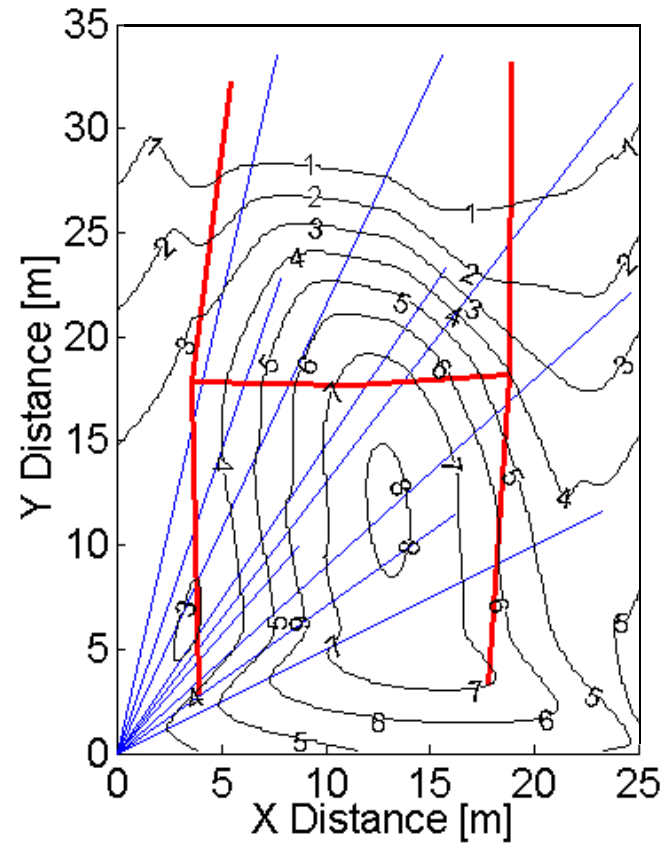


West

Dislocation Distance = 0.54 m; CCF = 0.98



West Point Release



Diesel Exhaust Plume Measurements

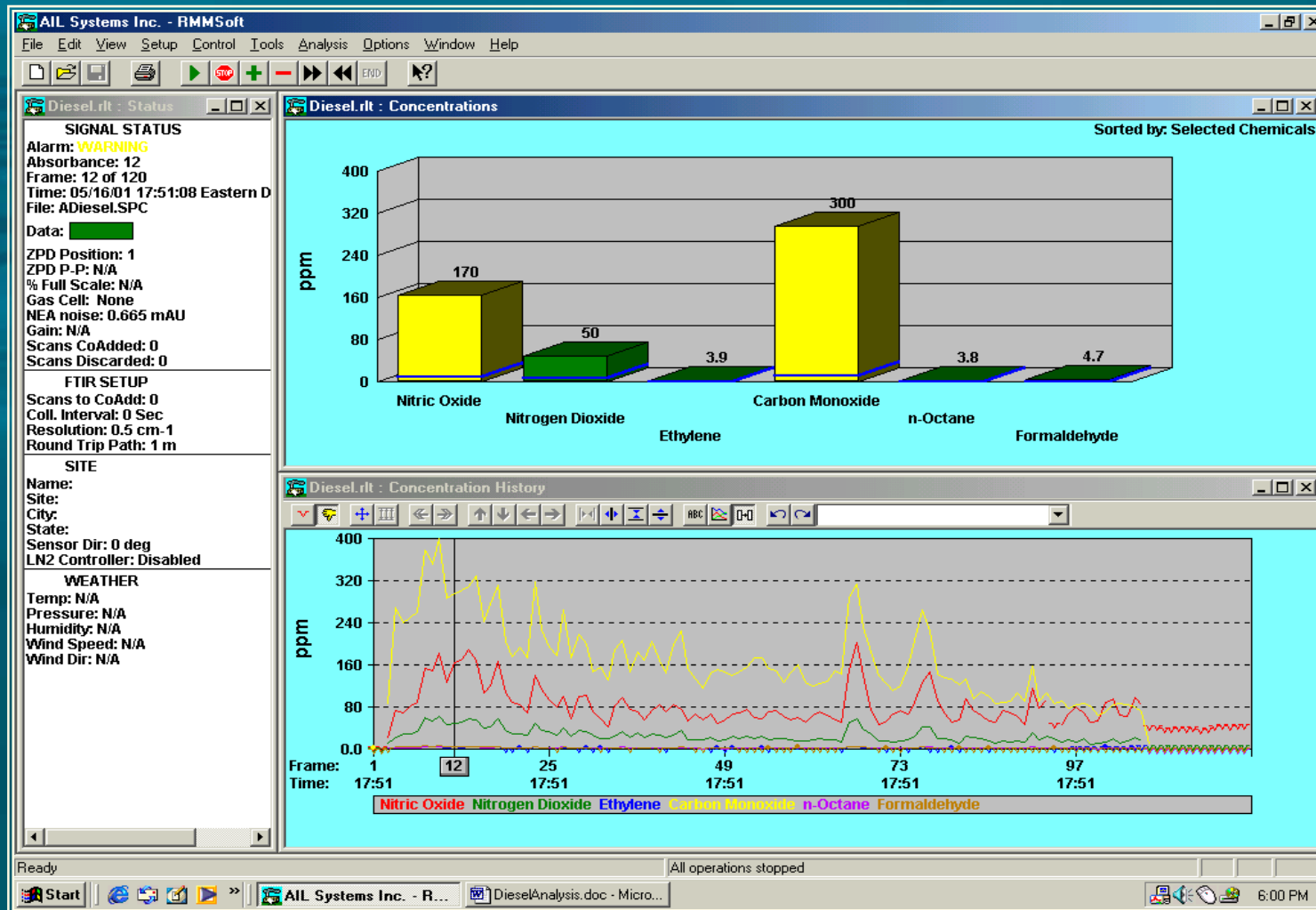
The ORS Measurement Setup

- OP-FTIR – Monostatic, Coaxial, Single-Telescope Design
- Beam Path – 7 Meters (One Way)
- Diesel Exhaust from a Stationary Class-8 Tractor Directed Through Infrared Beam

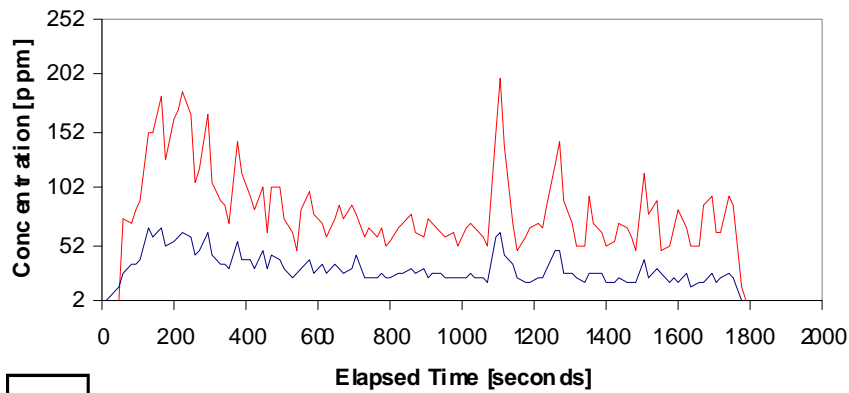
The Diesel Emissions Measurement Setup



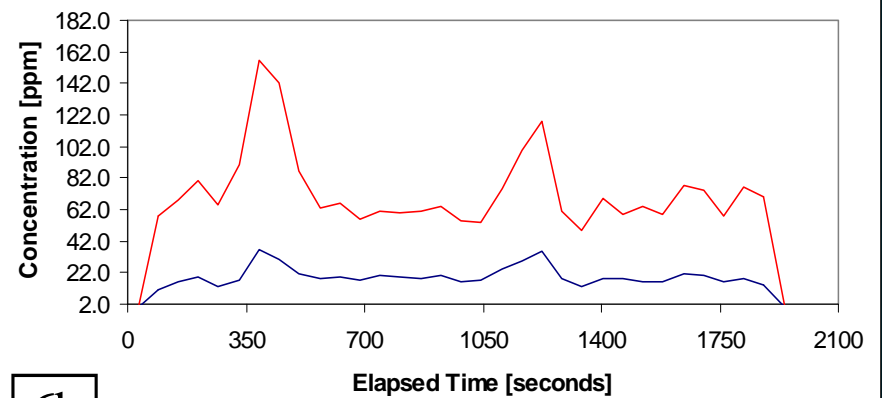
Diesel Emissions Time Plot



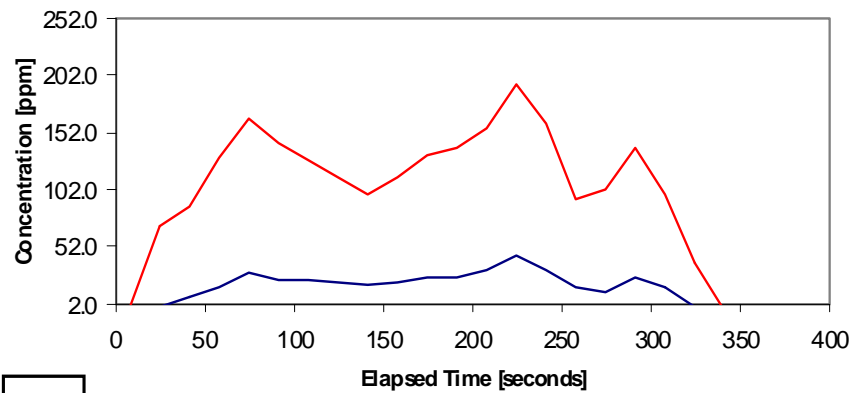
Time Plots of Measured NO and NO₂ Concentrations



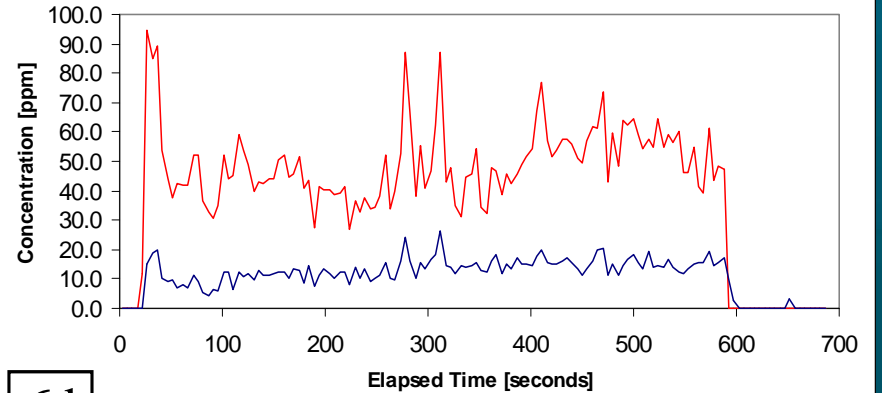
6a



6b



6c



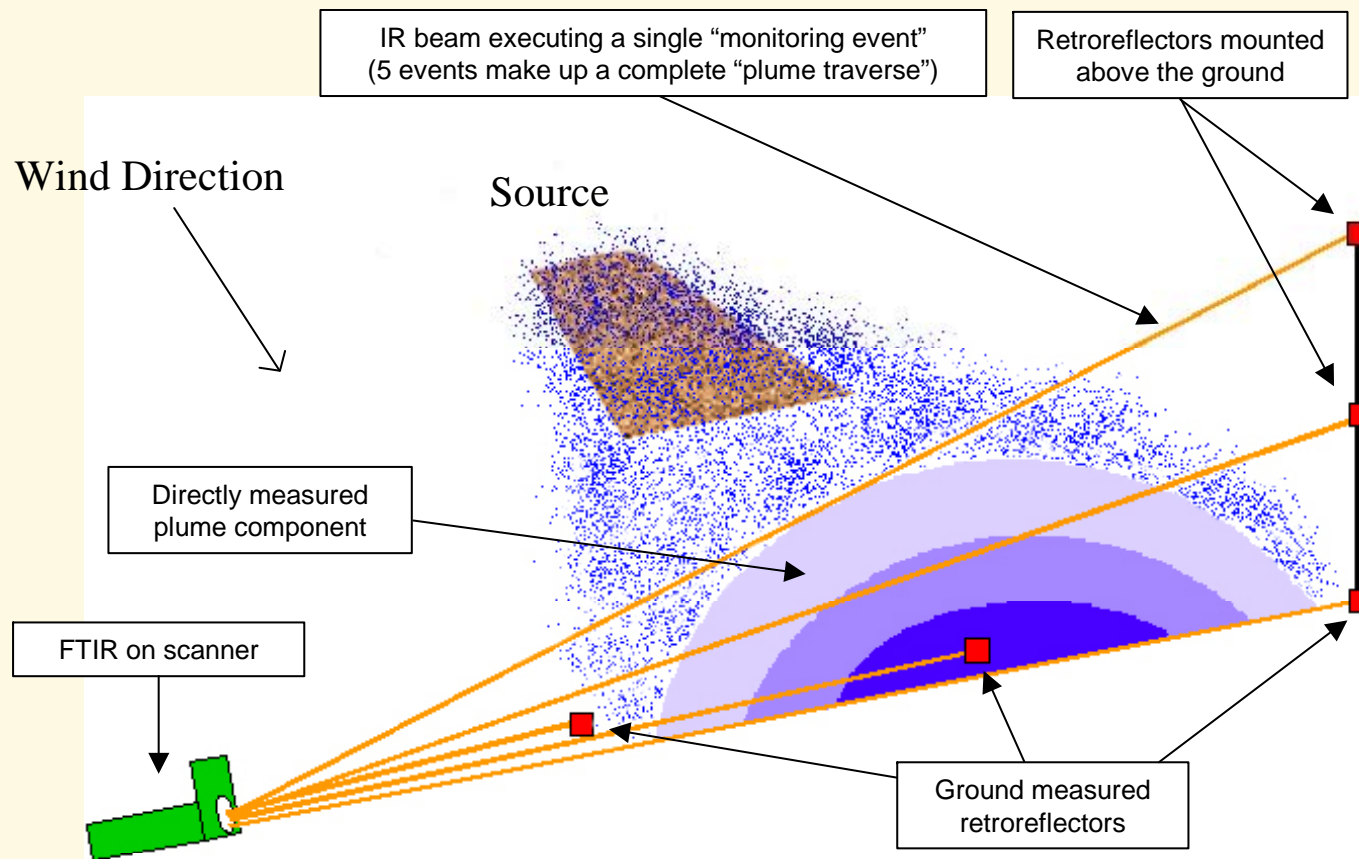
6d

Recent ORS Activities -- Emissions Monitoring

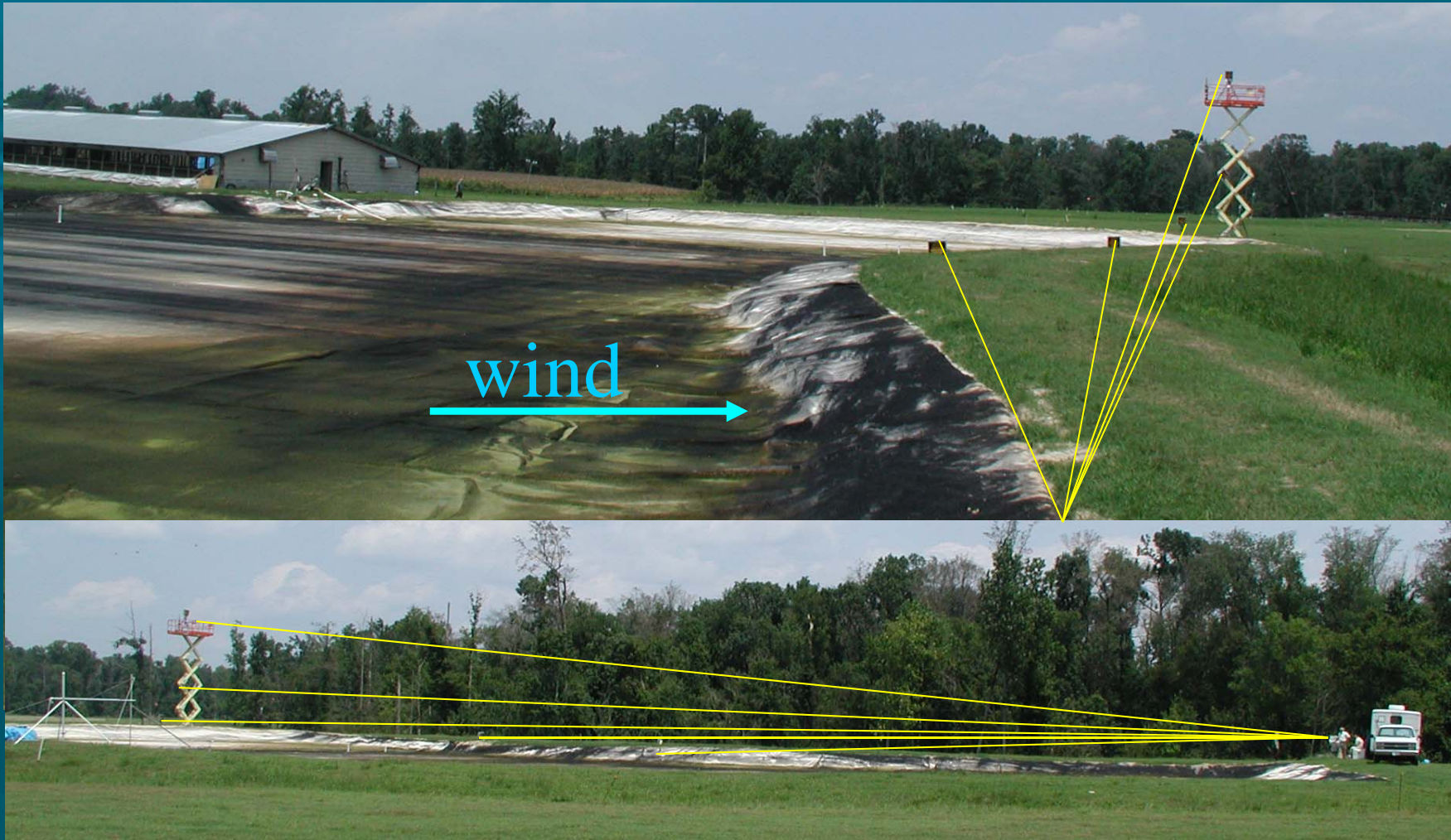
- Agricultural ammonia sources
 - Waste lagoon control via porous biocover
 - High-rise layer house
- Solid waste landfill

Agricultural Ammonia Sources

ORS Plane-integrated Interception and Measurement of Plume



OP-FTIR Measurement Paths



Seasonal Emission Rates

	Ammonia grams/min	Methane grams/min
7/11/2000 uncovered	20	40
8/16/2000 covered	4.7	66
2/28/2001 covered	0.84	62
8/15/2001 covered	1.2	Not Available

OP-FTIR at Layer House



250,000-Hen Layer House



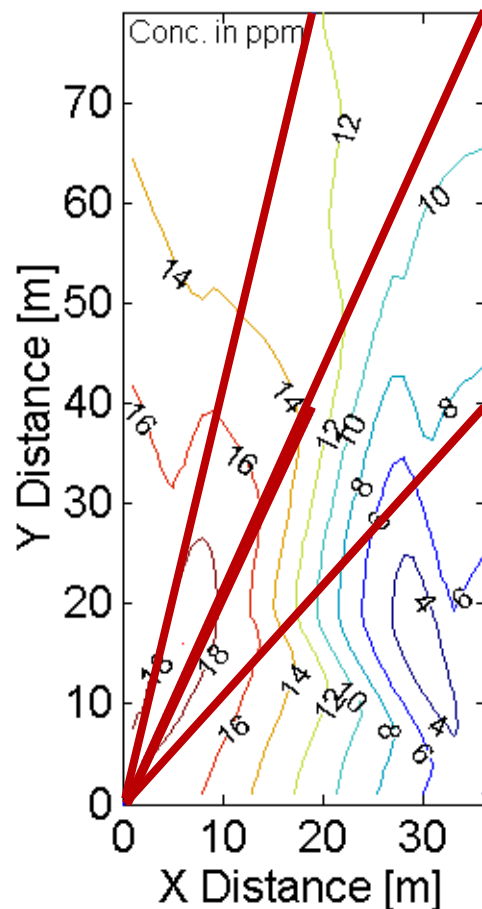
MSW Landfill Measurements

Scanner On Retrofit Unit

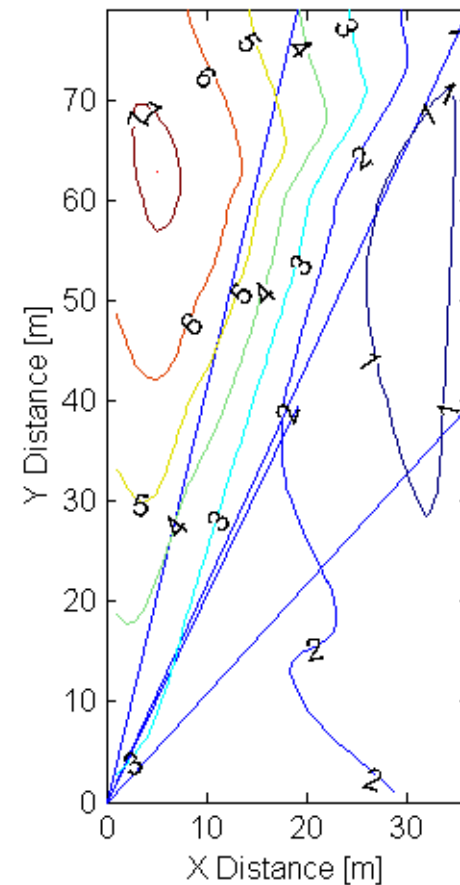


Four-Beam Reconstructions of Methane and Ammonia in a Landfill

Reconstructed Map # 5 North



Reconstructed Ammonia # 5 North



Future Activities

- Method improvement and application validation
-- DOD's ESTCP Program supported project
- Agricultural ammonia sources -- broilers, hogs, and cattle
- Landfills -- MSW bioreactors and brownfields
- Diesel emissions -- weigh station and cross road studies
- Incorporate Tunable Diode Laser (TDL) system into program

Summary

- Radial scanning has demonstrated the ability to locate point sources within the field of measurement
- Initial deployment of radial scanning on a large landfill is scheduled in September
- Plane-integrated (PI) OP-FTIR has been used to evaluate the effectiveness of a lagoon biocover to control ammonia emissions
- Single path and PI OP-FTIR measurements have been made on a large high-rise layer house - data analysis is not finished