

The seal of the Oklahoma City Air Logistics Center Environmental Management Directorate is a shield-shaped emblem. It features a central yellow circle with a black silhouette of a mountain range and a small airplane flying in front of it. The words "DIRECTORATE OF" are arched above the circle, and "ENVIRONMENTAL MANAGEMENT" is arched below it. The entire seal is rendered in a light gray, semi-transparent style.

**CASE STUDY: ENVIRONMENTAL MONITORING USING
REMOTE OPTICAL SENSING [OP-FTIR] TECHNOLOGY AT AN
INDUSTRIAL WASTEWATER TREATMENT PLANT**

Tinker Air Force Base, Oklahoma

**Freddie E. Hall, Jr., PhD
Chemical Engineer**

**OKLAHOMA CITY AIR LOGISTICS CENTER
ENVIRONMENTAL MANAGEMENT DIRECTORATE
POLLUTION PREVENTION BRANCH**



INVESTIGATION OVERVIEW

Outline



- Introduction
- Project Overview
- Distinctive Elements of Effort
- Air Emission Model
- Air Dispersion Model
- Coupled Model Validation / Calibration Process
- Coupled Model Results
- Comparison to Remote Optical Monitoring System
- Application to Risk Assessment
- Summary and Conclusions





TINKER AFB, OKLAHOMA

Introduction



- Tinker AFB covers 5,031 acres
 - *Only 200 acres are undeveloped*
- 765 Facilities
 - *15.3M feet² of industrial operations*
- Three Creek Systems
- 700-plus Air Emission Sources
- 200 Underground Storage Tanks
- 11-Miles Industrial Wastewater Lines
- Three Wastewater Treatment Plants
- 36 Restoration Sites
- Provides Logistics Support to USAF Weapon Systems
 - *B-1, B-52, E-3 Sentry, C/KC-135 aircraft*





TINKER AFB, OKLAHOMA

Introduction [CONTD]



- Tinker AFB performs Depot Level Maintenance
- Process Assessment identified four Primary Processes
 - *Depainting, Painting, Electroplating & Cleaning*
 - *Majority of processes discharge to an on-base treatment facility*
- Regulatory Requirement to quantify Air Emissions from Industrial Wastewater Treatment Facility [IWTF]
 - *Toxic Release Inventory and Air Emission Inventory*
 - *Clean Air Act Title V permit requires source & emission information*
 - *POTW NESHAP requirement*
- Efforts focus on Methylene Chloride and Phenol
 - *Both are CAA Title III Listed Hazardous Air Pollutants [HAPs]*
 - *VOC and semi-VOC examples*
 - *These chemicals account for majority of purchases / releases*



ENVIRONMENTAL MONITORING

Project Overview



- Investigation will be presented in four Major Tasks
- Coupling of Emission and Dispersion Models represents a Cost-Effective and Environmentally-Responsible Approach
 - *Coupling refers to sequential use of models [output is input]*
 - *Meet impact predictions, regulatory reporting requirements, and pollution prevention needs*
 - *Estimate emissions from IWTP process units*
 - *WATER8 air emission model developed by EPA*
 - *Estimate atmospheric dispersion concentrations*
 - *ISC-ST3 air dispersion model designed by EPA*
 - *Validate predictive accuracy of the coupled model*
 - *Comparison of coupled model predictions to field data*
 - *Comparison of coupled model predictions to OP-FTIR data*
 - *Demonstrate potential applications to include Risk Assessment*

**Coupled
Model**



ENVIRONMENTAL MONITORING

Uniqueness of Investigation



■ Distinctive Elements of Investigation

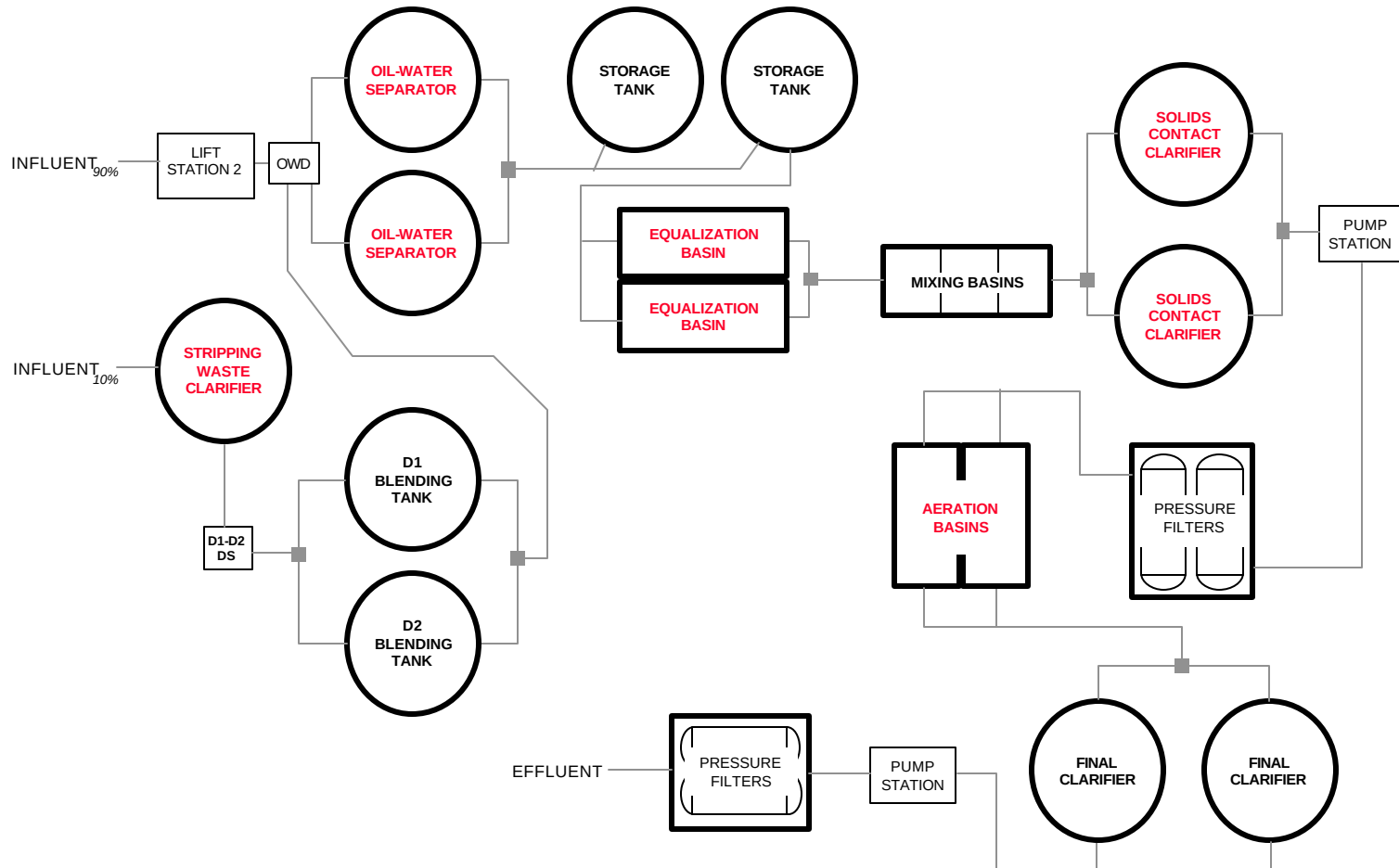
- *Combined use of WATER8 and ISC-ST3*
- *Literature directed to specific applications*
- *Coupled model compared to MAAC*
- *Literature limited to single emission sources*
- *Literature focused at municipal wastewater treatment*
- *Detail and size of periodic canister data*
- *Investigation of three remote optical paths*
- *Multiple retroreflectors that bend optical path*
- *Evaluation of chemical depainting agents*
- *Coupled model used in risk assessment*
- *Completeness and comparative analysis*

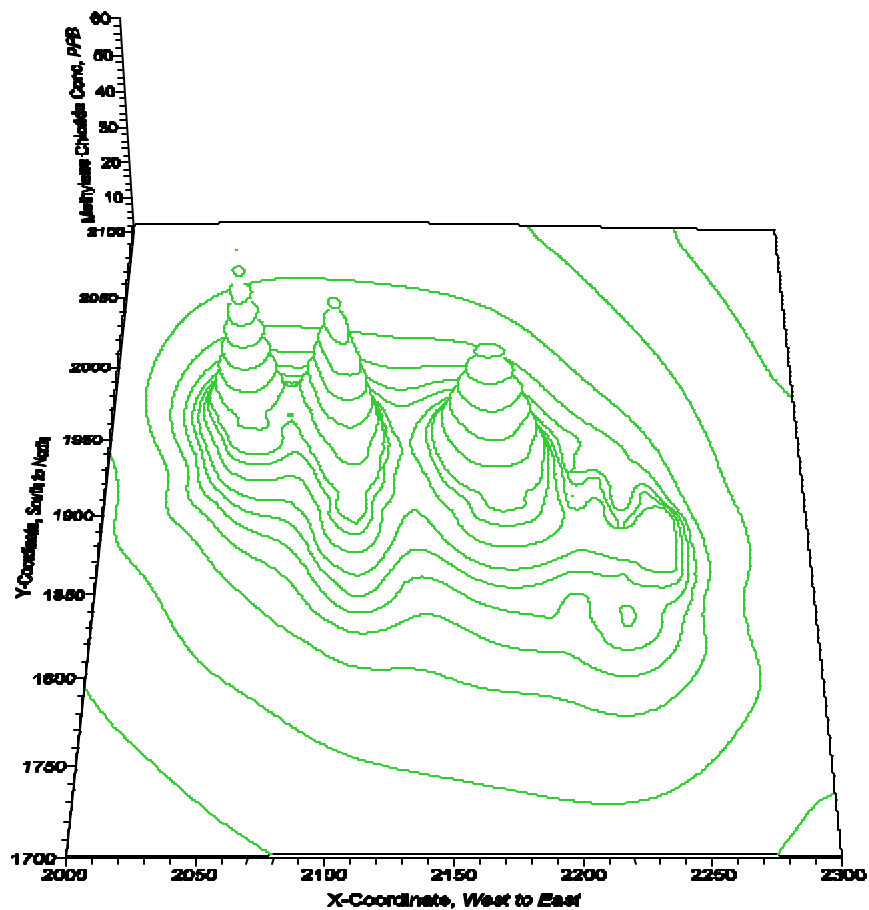
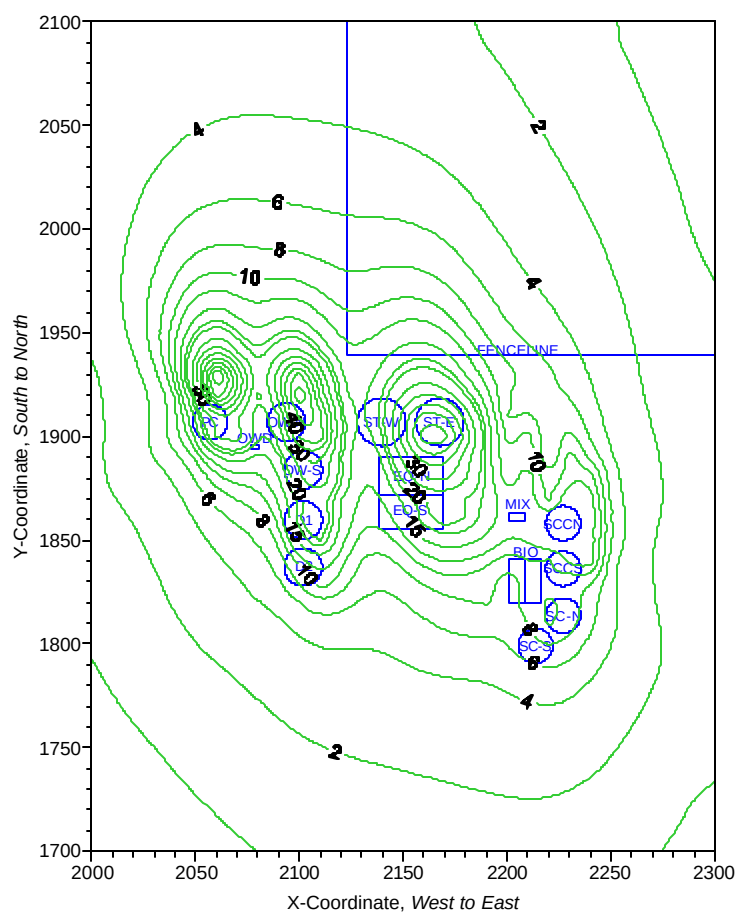




IWTP PROCESS FLOW DIAGRAM

Primary, Secondary, & Tertiary Treatment

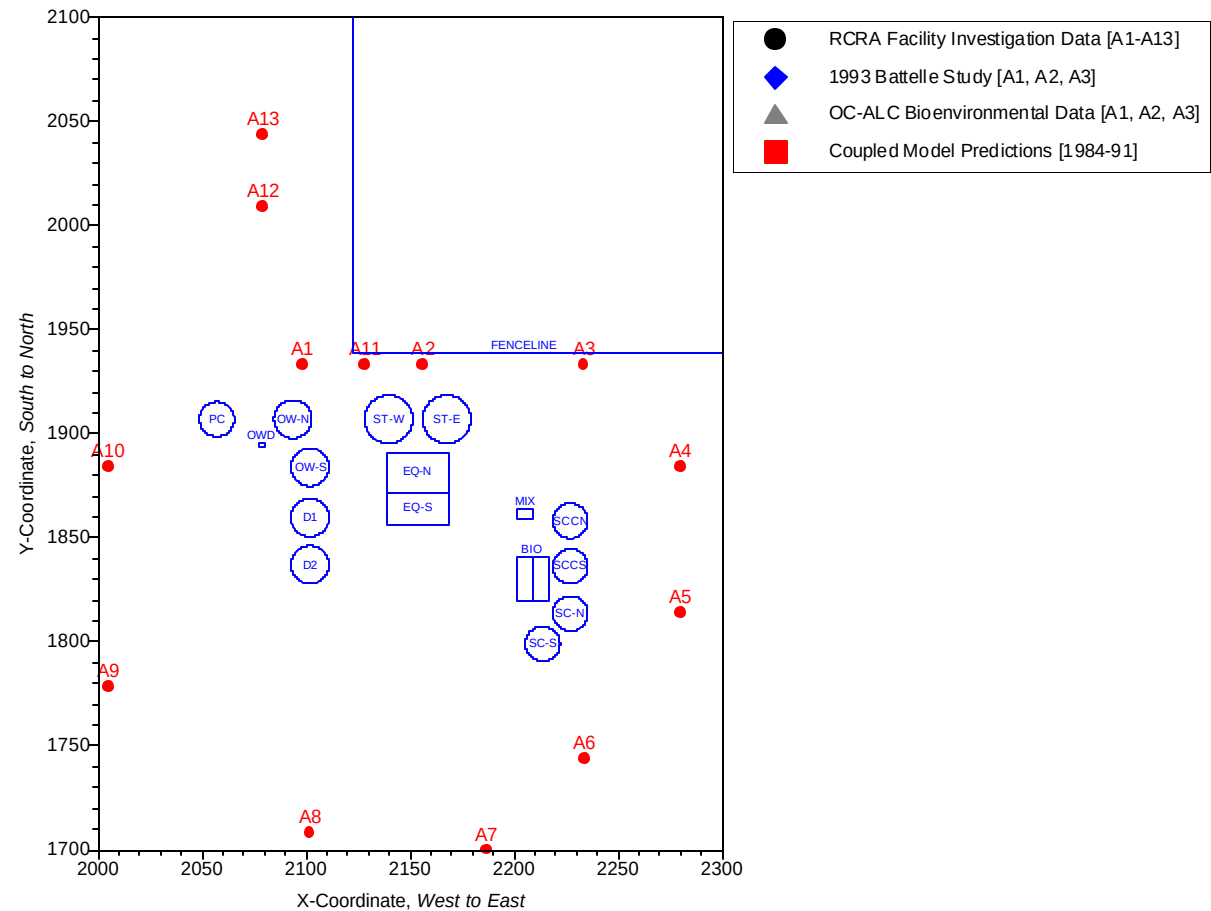






ENVIRONMENTAL MONITORING

Location of Periodic Canister Data





OPEN PATH MONITORING SYSTEM

Fourier Transform InfraRed Spectroscopy

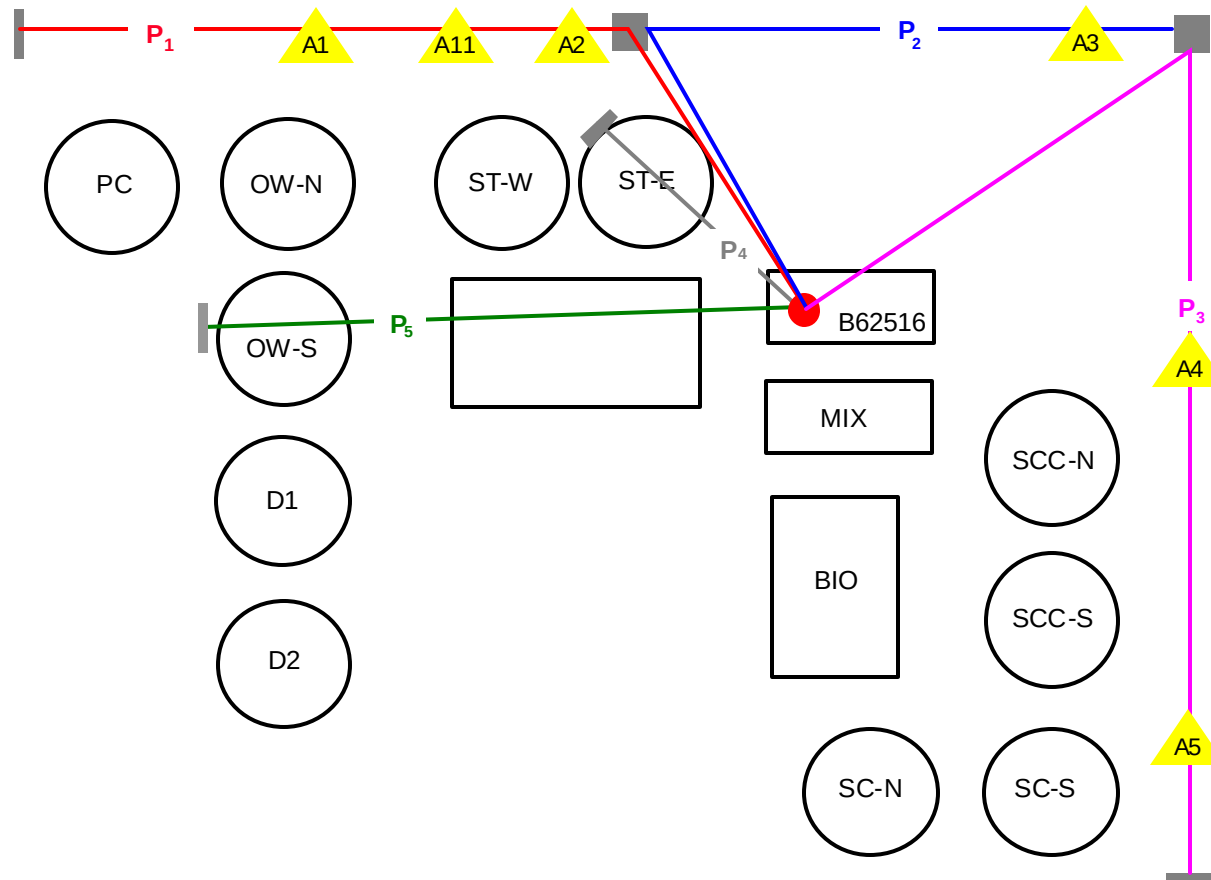


- Open-Path Monitoring System measures Atmospheric Emissions
 - *Directing infrared optical energy along physical path that crosses downwind of emission source plume*
 - *OP-FTIR system used for environmental monitoring*
- Pollutants modify Spectral Signal
 - *Allows for determination of identity and quantity of pollutants*
- OC-ALC Application consist of OP-FTIR Spectrometer
 - *Operated in monostatic configuration*
 - *Designed to measure atmospheric dispersion concentrations along five distinct optical paths*
 - *Primarily concerned with fence line concentrations $[P_1, P_2, P_3]$*
 - *System installed in 1995 and operational roughly three months*
 - *36 percent of collected FTIR data considered unusable*



OPEN PATH MONITORING SYSTEM

Remote OP-FTIR Optical Monitoring Pathways

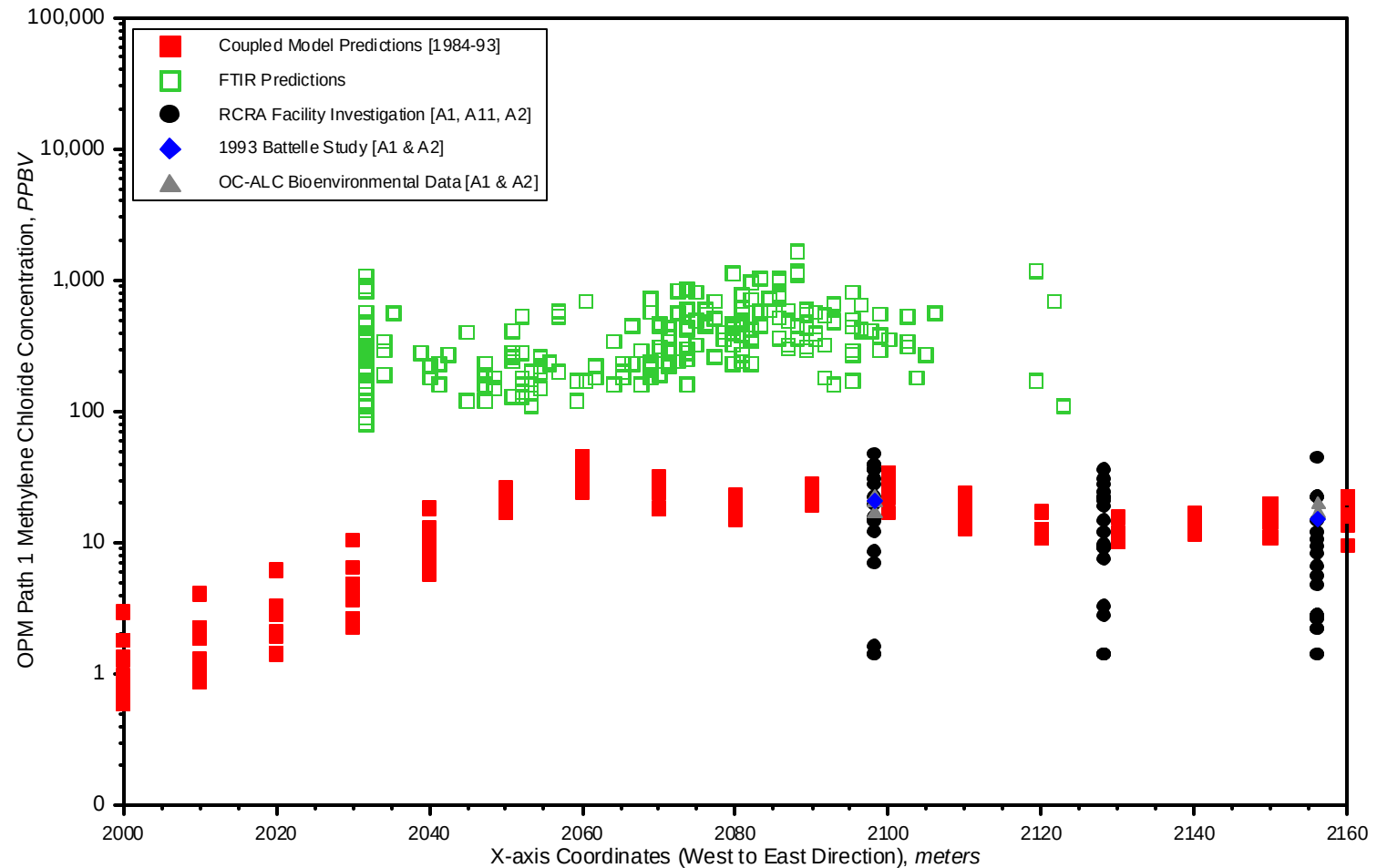






OPM SYSTEM COMPARISON

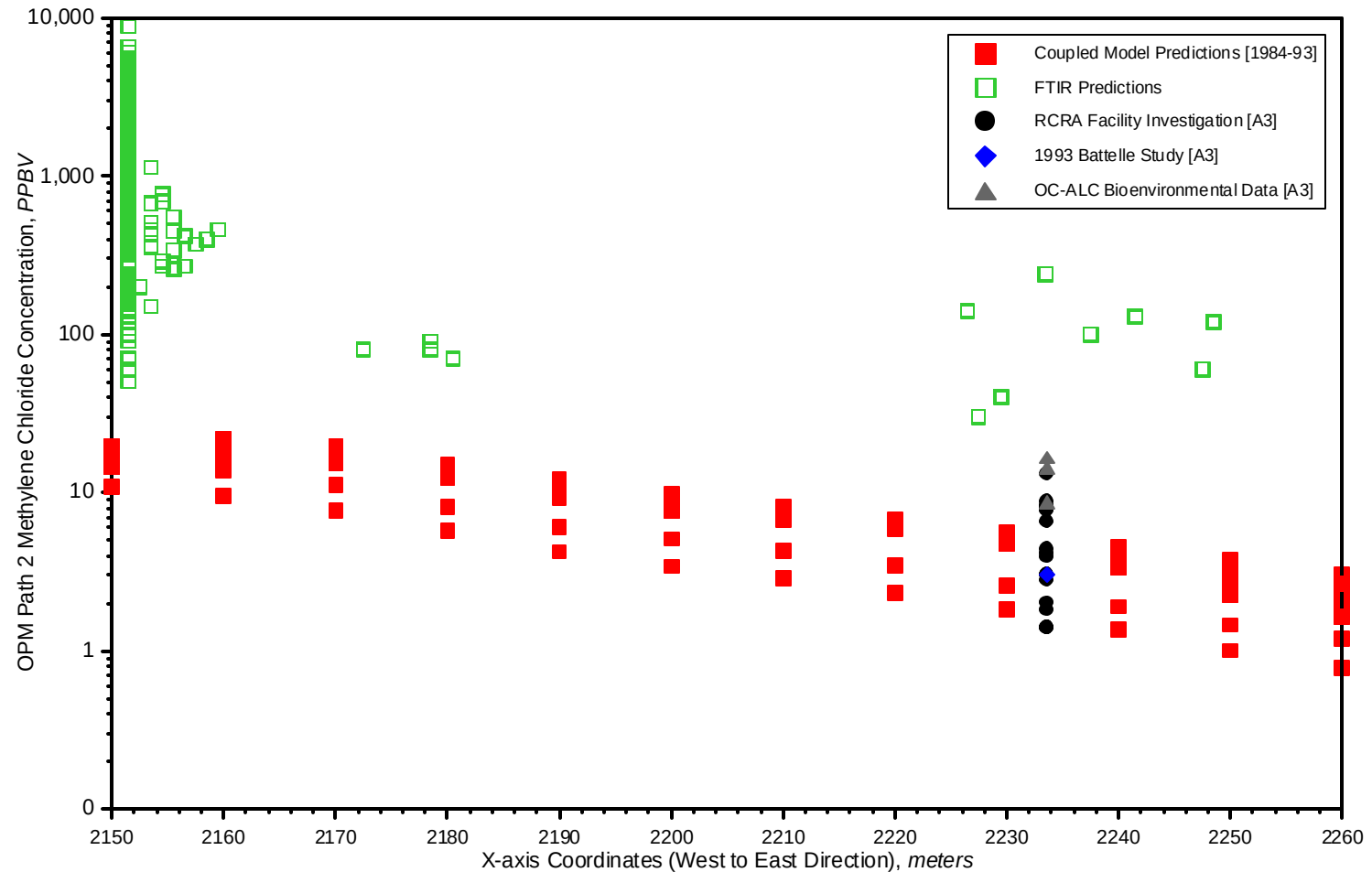
Methylene Chloride--Optical Path P1





OPM SYSTEM COMPARISON

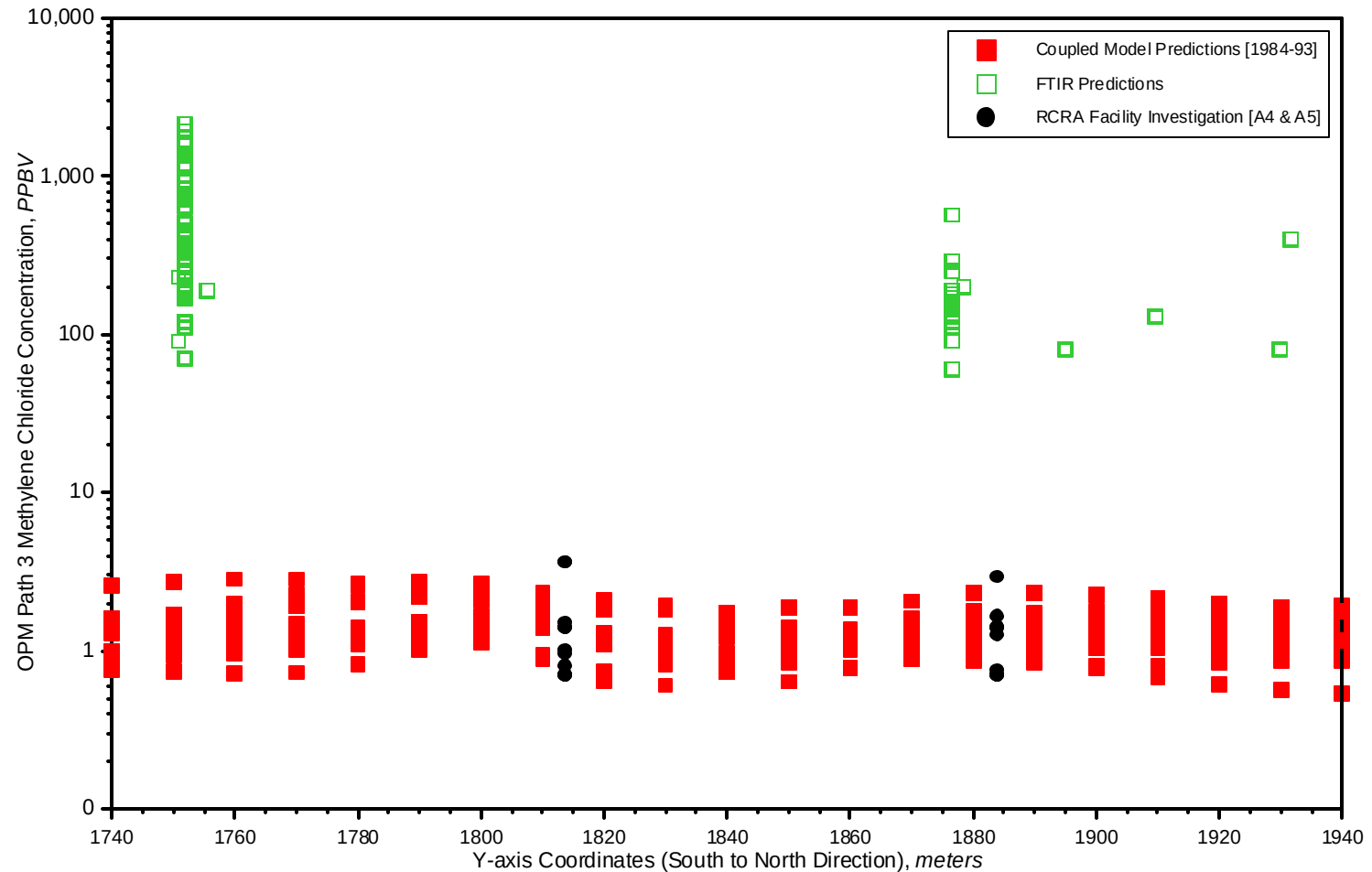
Methylene Chloride--Optical Path P2





OPM SYSTEM COMPARISON

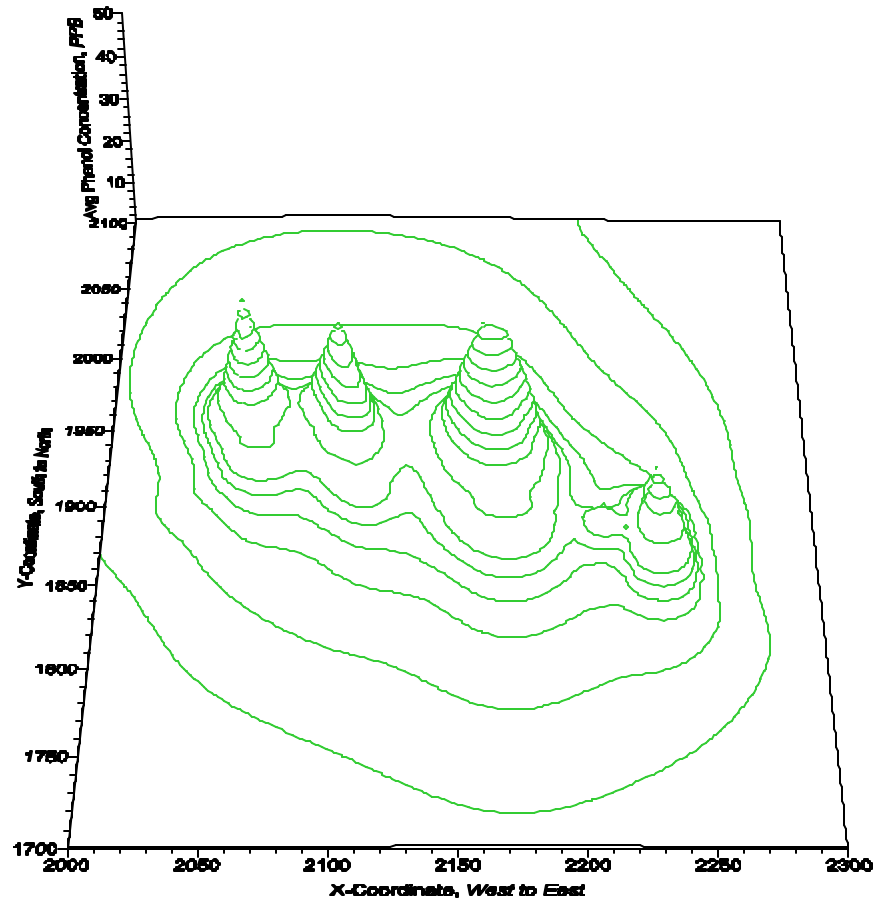
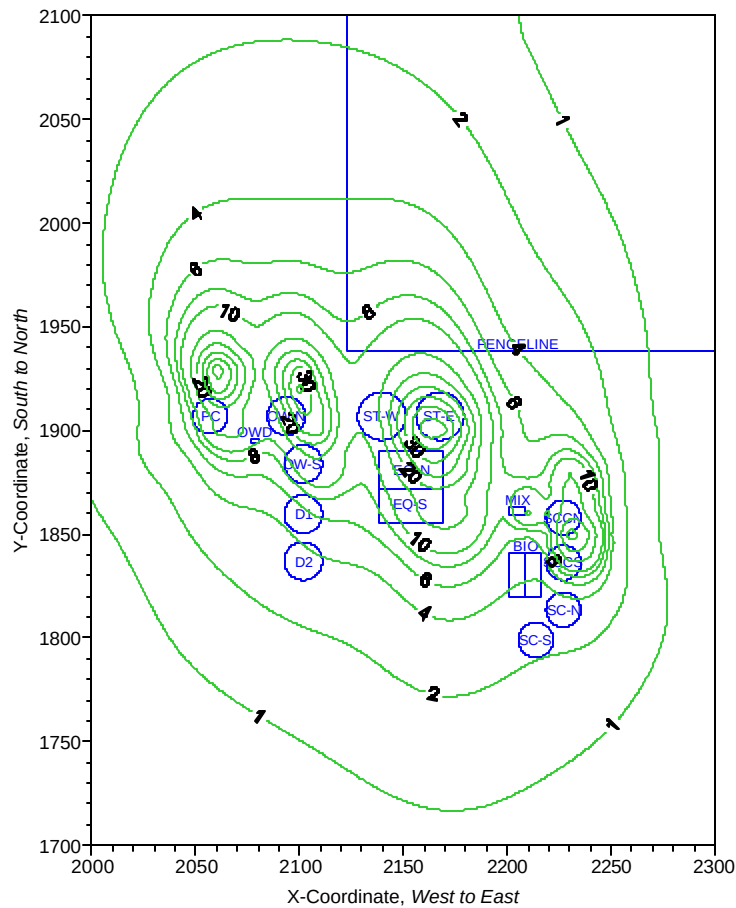
Methylene Chloride--Optical Path P3





COUPLED MODEL OUTPUT

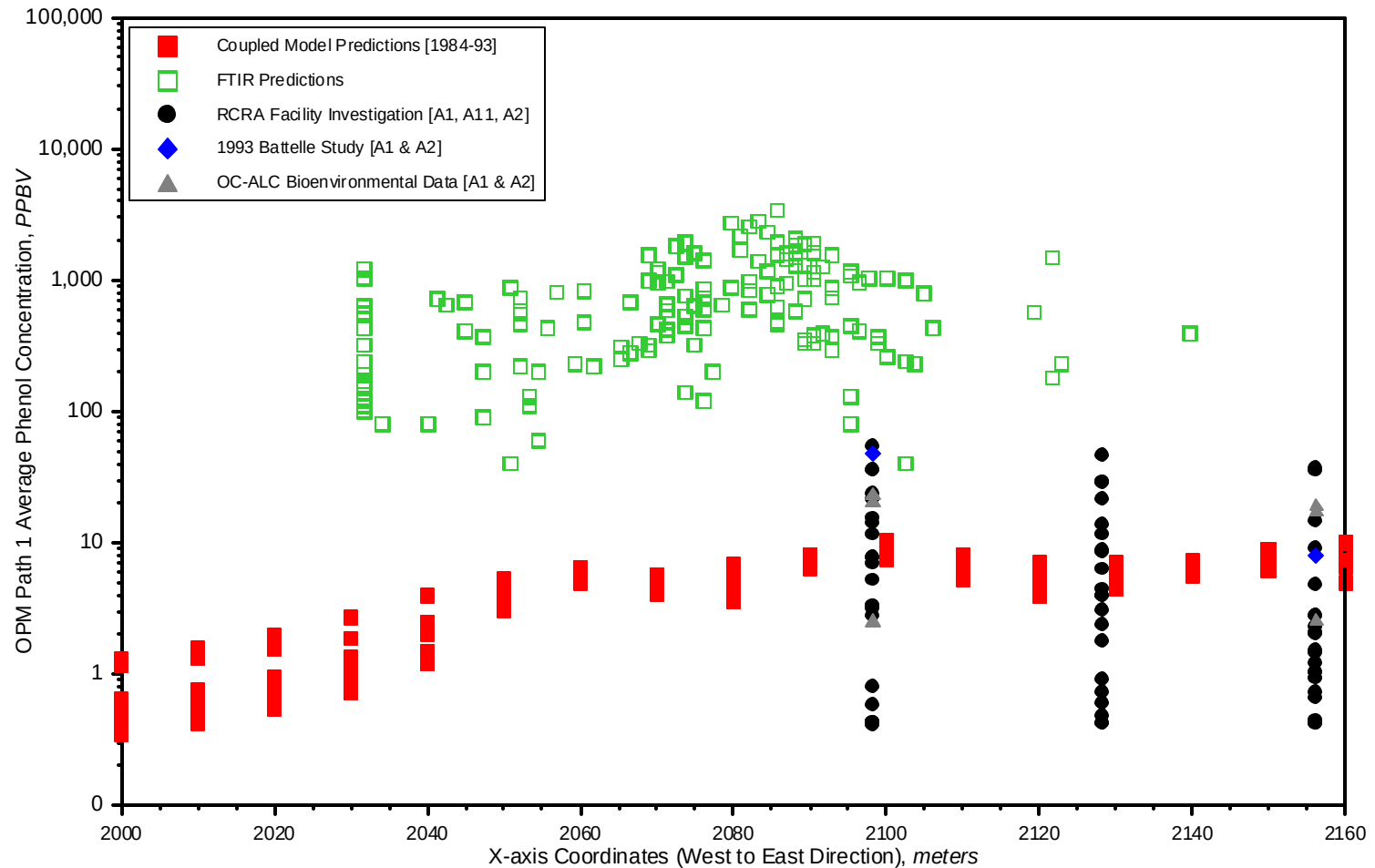
Maximum Phenol Concentrations, PPB





OPM SYSTEM COMPARISON

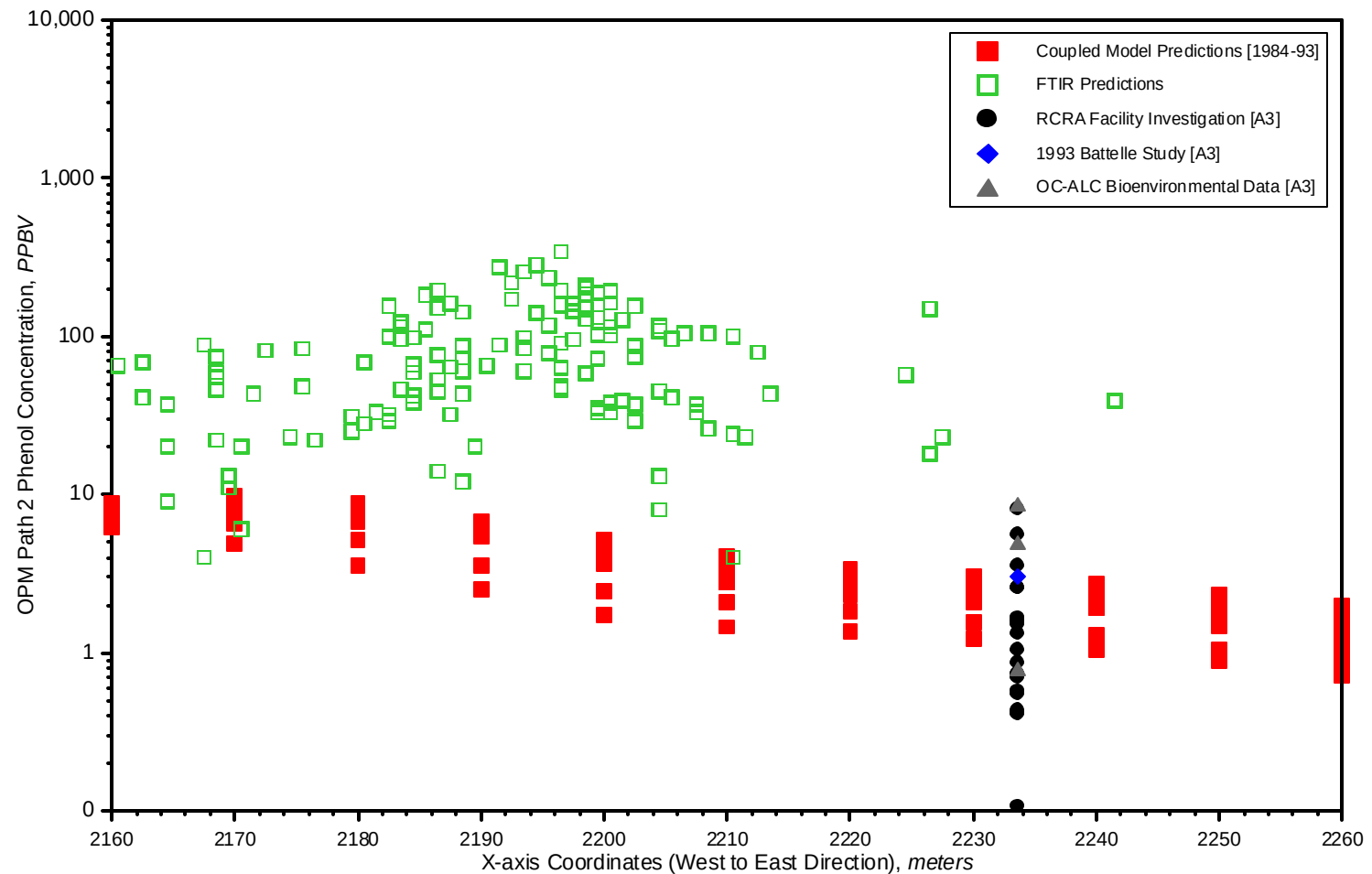
Phenol--Optical Path P1





OPM SYSTEM COMPARISON

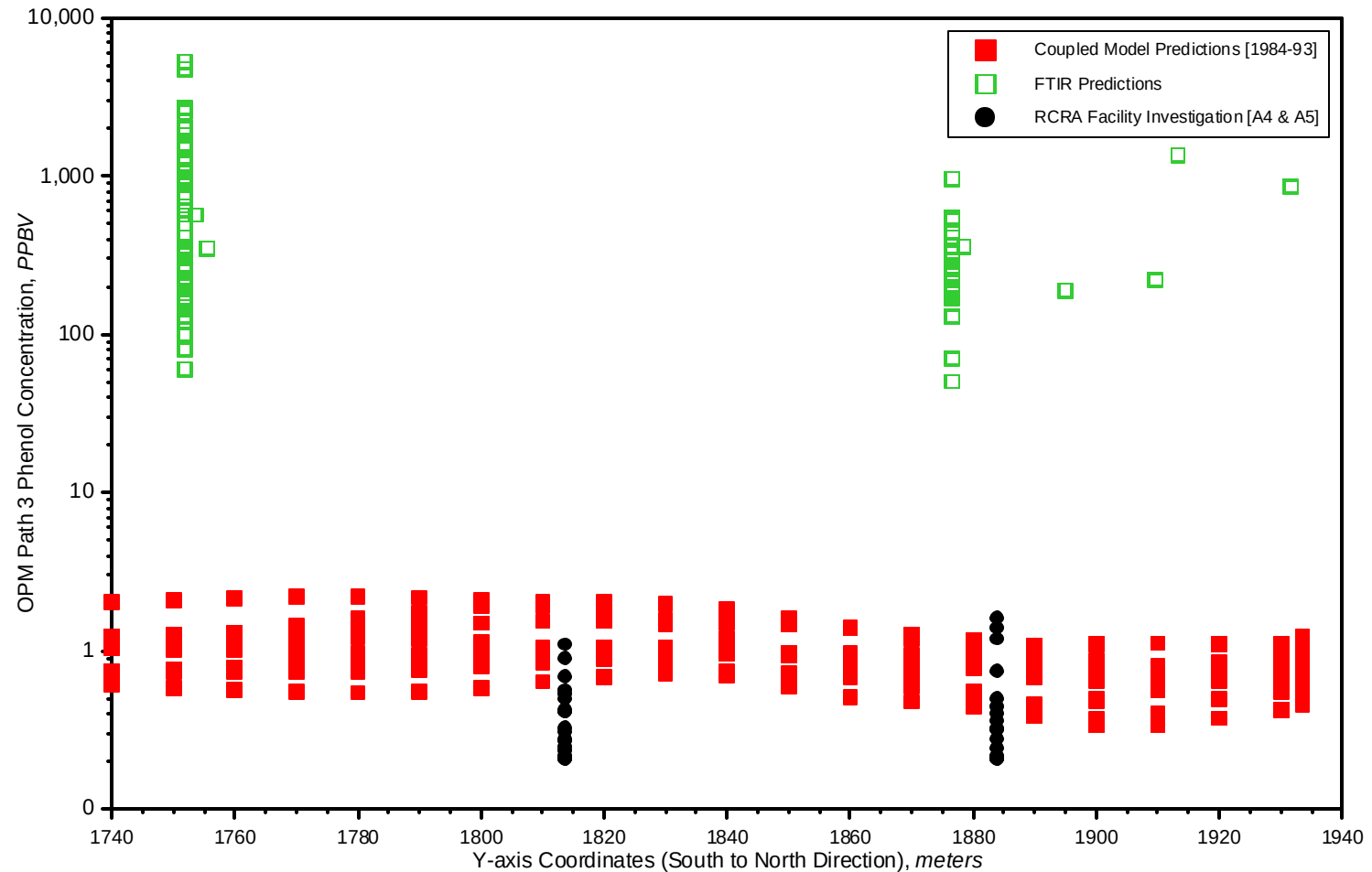
Phenol--Optical Path P2





OPM SYSTEM COMPARISON

Phenol--Optical Path P3



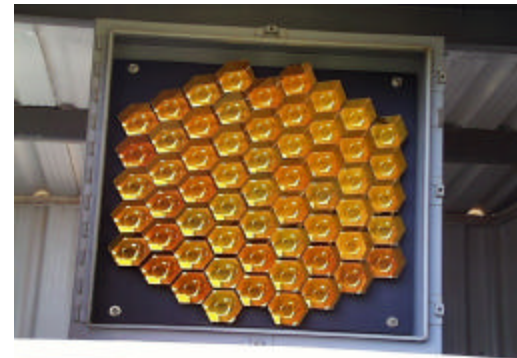


ENVIRONMENTAL MONITORING

Summary & Conclusions



- OP-FTIR Ineffective Method of Predicting Field Data
 - *FTIR over-predicts field data along all three optical paths*
 - *FTIR data gathered over 12 months*
 - *FTIR over-predicts by orders of magnitude*
 - *No visual trends for both components*
 - *Clustering of data along optical path*
- Reliability of Technology
 - *Three months worth of data over five years*
 - *36% of data considered unusable*
- Potential Weaknesses
 - *Poor maintenance and oversight*
 - *Weather data equipment and software*
 - *No daily background spectra*
 - *Significant water vapor impacts*



The logo is a shield-shaped emblem. At the top, a banner reads "DIRECTORATE OF". The center features a stylized eagle with its wings spread, perched on a globe. Below the eagle, a banner reads "ENVIRONMENTAL MANAGEMENT". At the bottom, another banner reads "AIR FORCE ENVIRONMENTAL MANAGEMENT ALC".

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Tinker Air Force Base, Oklahoma

**Freddie E. Hall, Jr.
OC-ALC/EMPD**

**7701 Arnold Street, Suite 204
Tinker AFB OK 73145-9100**

COM: 405-734-3114

DSN: 884-3114

EMAIL: freddie.hall@tinker.af.mil