Rapid Assessment Tools

A new technological advancement presented by the Field Environmental Decision Support (FIELDS) team of the USEPA Region 5 Superfund Division

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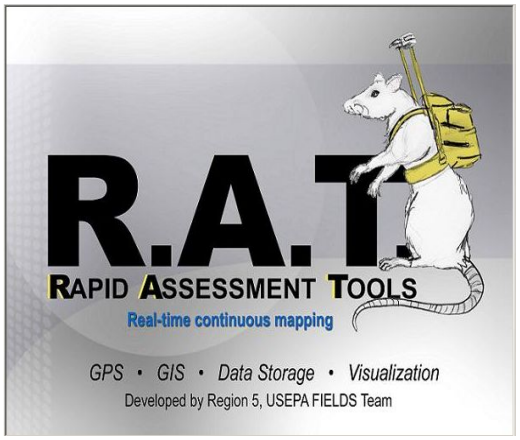

Version 1.5
Available for Download

New Version
Estimated Release Date:
September 2006

Web address: www.epa.gov/region5fields

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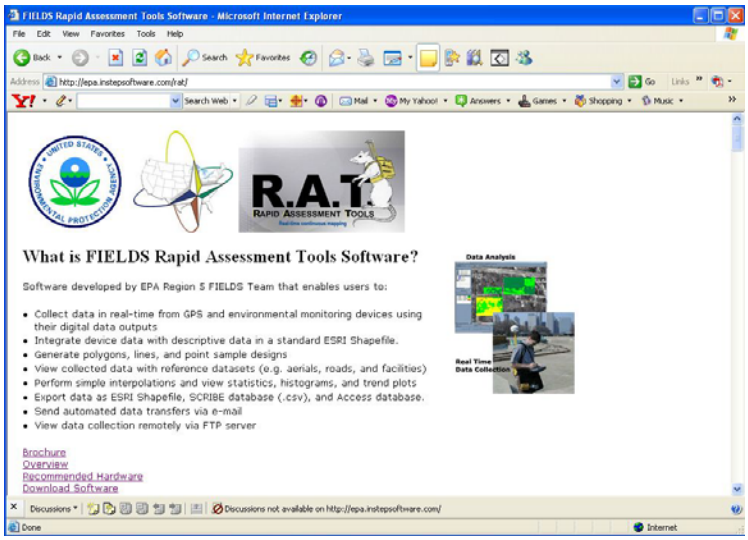
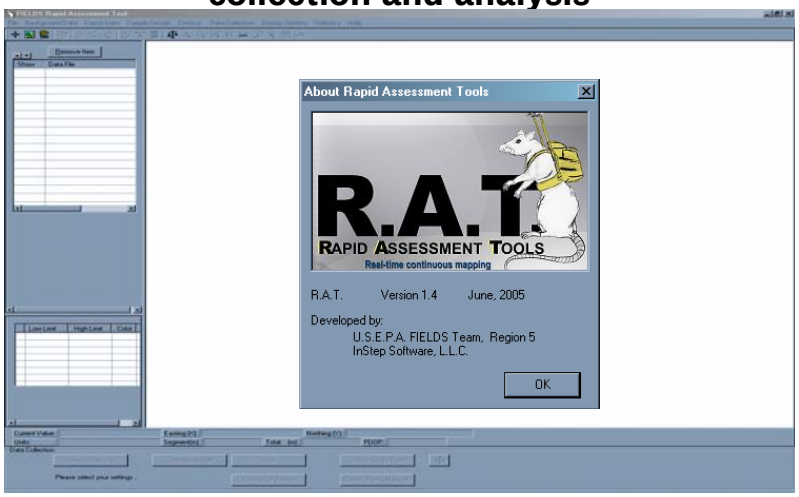
RAT Website



- http://epa.instepsoftware.com/rat/

Why Develop RAT?

Currently, poor real-time spatial data collection, storage, and visualization techniques are used for in field data collection and analysis



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Rapid Assessment Tools (RAT)

- **Developed in-house as a stand-alone application**
- **Data is collected & captured “hands-off”**
- **Uses multiple devices (Radiation, Air, Soil ….)**
  - Manual, Single, and Continuous Point Collection
- **Real-time spatial visualization**
- **Immediate data storage and GIS file creation**
- **Data export**

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Development & Application History

- October 2003
  - Began Rapid Assessment Tools programming
- November 2003
  - Mapped a simulated car dirty-bomb using RAT for USEPA's "Operation River City" in Louisville, Kentucky.
- February 2004
  - Presented RAT to ERT team in Edison, New Jersey
- May 2004
  - Demonstrated the new viewer and database capabilities in the "Detroit Weapons of Mass Destruction Exercise".

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Development & Application History

- July 2004
  - "Ruby Slippers Exercise" - Utilized RAT extensively for a simulated downed satellite in Fort Leavenworth, KS.
- August 2004
  - Presented RAT to the USEPA's Cincinnati ERT office.
  - Proposed adding ERT's Scribe database export to RAT
- September 2004
  - Discussion with PacketHop Corporation in CA about deployment of a wireless mobile communication software that can be used in conjunction with RAT.
- November 2004
  - OSC Readiness training in Phoenix, Arizona. Three hour seminar utilizing RAT with WIFI radio communications in a live demonstration exercise.

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Development & Application History

- December 2004
  - Conducted an XRF survey surrounding the Jacobsville Lead Superfund Site, Evansville Indiana. Collected over 50 composite locations incorporating 250 lead sample cores for residences surrounding the site.
- February 2005
  - A 2 day training for START contractors was conducted with an outdoor and hands on demonstration utilizing RAT with a GPS, radiation and air monitoring, and transportation devices.
- May 2005
  - Presented RAT at the EPA technology forum in Washington DC with a focus on data storage the use of wireless connectivity with real-time data collection.

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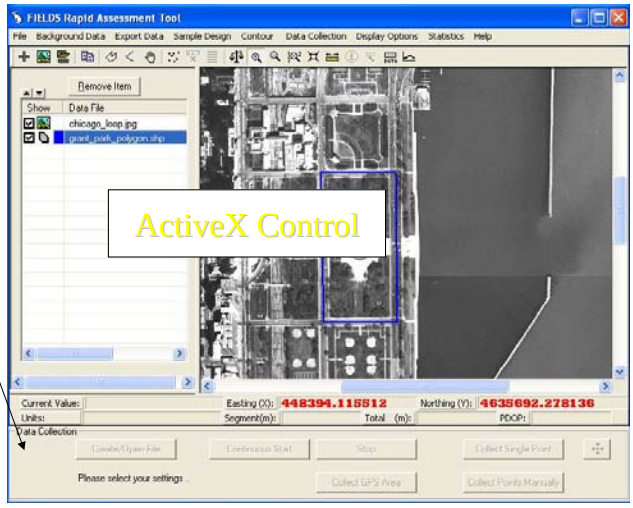
RAT Field Applications 2005/6

- **Scio Pottery** – Removal Action, Lead (OSC Jim Augustyn)
- **Plastics Fire** – ER Perimeter Monitoring (OSC Steve Renninger)
- **Tire Fire** – ER Perimeter Monitoring, VOCs (OSC Jim Mitchell)
- **Warren Recycling** – Removal Action of H2S (OSC Mark Durno)
- **All-Star Game** – ER Predeployment for mobile perimeter monitoring
- **Styrene Response** – ER Perimeter Monitoring
- **CMC Properties**, Minneapolis, MN – Superfund Site Assessment for Arsenic in Soil (Tim Prendeville, RPM)
- **Jacobsville**, IN – Continued Superfund Site Assessment for lead in Soil (Jena Sleboda Braun, RPM)
- **Taylor Springs**, IL – Superfund removal for lead in residential neighborhood (OSC Craig Thomas)

RAT Architecture

Visual Basic



In progress:

• Conversion to .NET framework *(June, 2006)*

- ✓ multi-threading
- ✓ multi-com port retrieval

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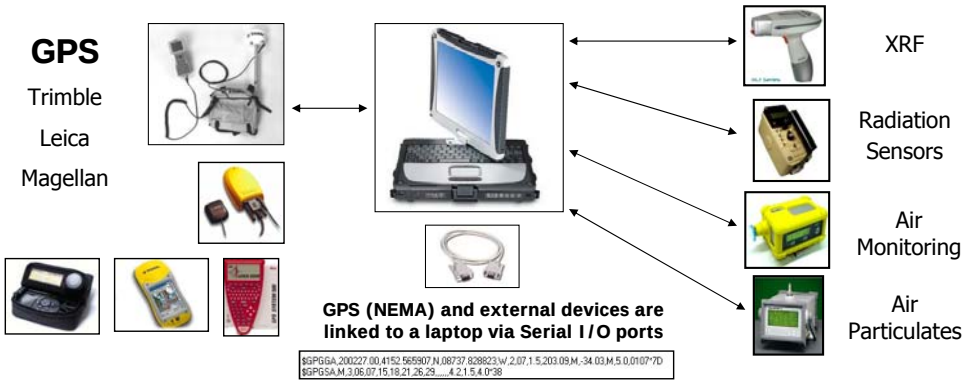
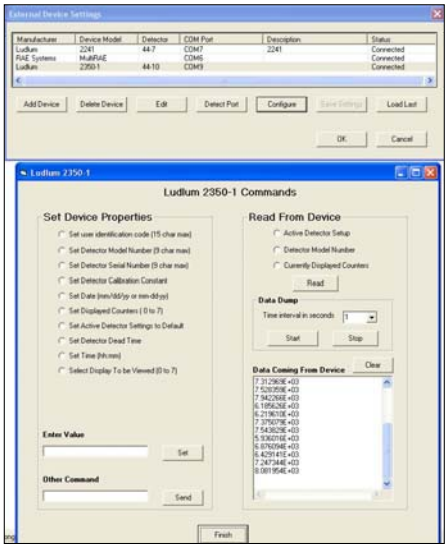
Hardware Integration



- Any GPS that sends a standard NMEA string can be used depending on accuracy required. This gives you real-time locations requiring no post processing.
- Any sensor device both analog and digital can be incorporated into the software. Up to three sensors with GPS can be configured at one time.

Integrated Devices

- **Radiation Devices**
  - Ludlum 2221 Data logger
    - single value data output
    - half-duplex (data out only)
  - Ludlum 2350 & 2241 Data Logger
    - Full Duplex (logger sends & receives)
    - Scaler, count, & dose dump)
  - Innovision 451P
- **Air Monitoring Devices**
  - MultiRAE
    - Over 14 sensors available from RAE Systems (CO, H_2S, VOC's, O_2, LEL, etc.)
  - Data RAM
    - Particulates, Temperature, Humidity, etc.
  - Draeger Multiwarn
    - **(CO, H2S, VOCs, Toxics)**
- **Soil Monitoring Devices**
  - XRF
    - Over 23 different Metals



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EPA Deployment Options

Personal

Backpack system

- Single device
- Move through tough terrain

Motorized

Kawasaki 4X4 Mule

- Ability to carry multiple devices
- Power plug-in
- Carry multiple people

Mobile

Push Cart System

- Ability to run multiple devices
- Carry batteries for WIFI, GPS, and devices

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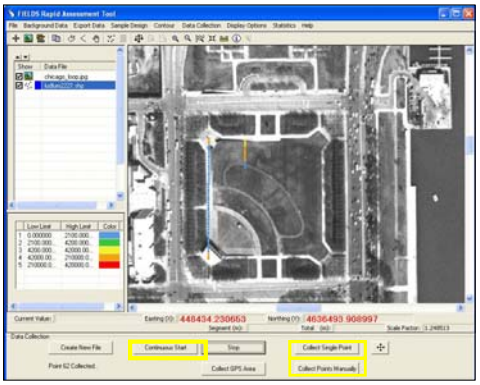
Collecting Data in RAT

- **Continuous Collection**

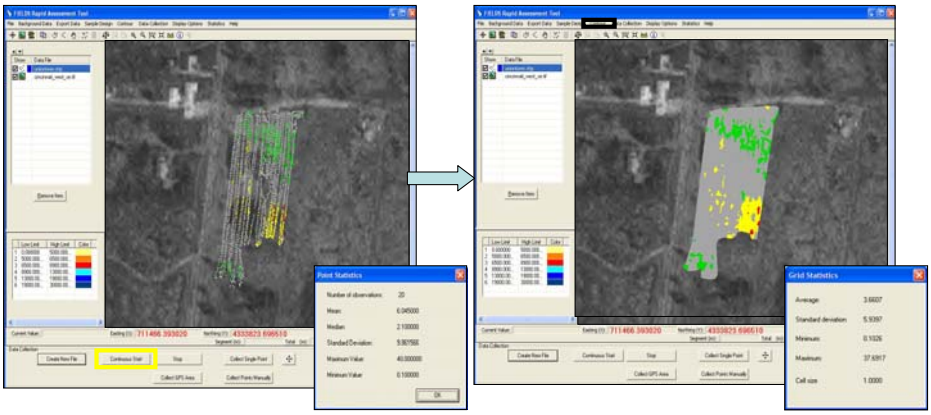
- **Single Point Collection**



- **Manual Collection**
  - No electronic input or not integrated
  - An electronic data dictionary can be created

Contouring and Analysis

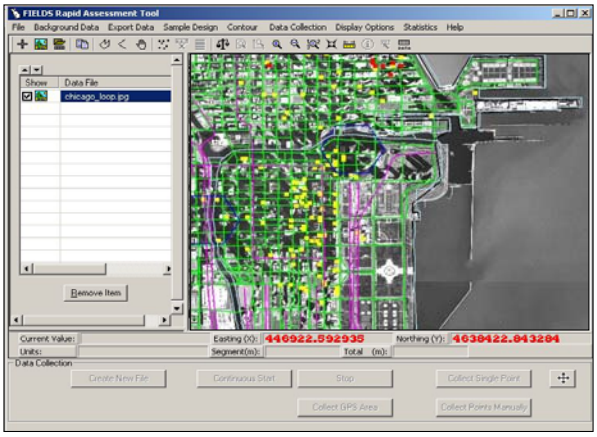
Collected data can be contoured at any time allowing easy visualization of data trends. Statistical Tools allow point and grid files to be summarized for quick trend and action level analysis.



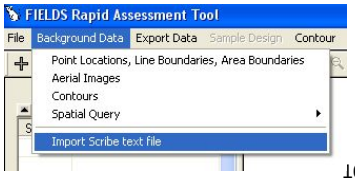
IEL site, Uniontown, Ohio (Radiation Survey), November, 2003

Data Import/Export

- **ESRI shapefiles which include: points, lines, and polygons**
- **DBFs**
- **CAD files**
- **Aerial Imagery & ESRI Ascii grids**



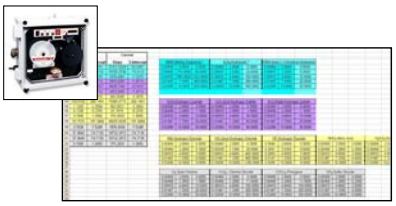
- **Images must have world files**
  - World files are text files that contain corner coordinates for the aerial image.
  - TIFF's = *.tfw
  - JPEG's = *.jgw
- **Scribe**
  - Lat/Long to UTM converter



Future Development

- **New sensor integration**
  - SAM 935
    - Portable spectroscopy
    - Identifies multiple radionuclides

  - Zellweger SPM
    - Ppb air monitor
    - Slope conversions for over 50 chem keys
    - Wireless perimeter monitoring



- Training Center

Rapid Assessment Tools Hardware

Primary Hardware Components

1. Laptop
2. GPS Receiver
3. Monitoring Device(s)

Air Monitoring Device

Ruggedized Laptop

GPS

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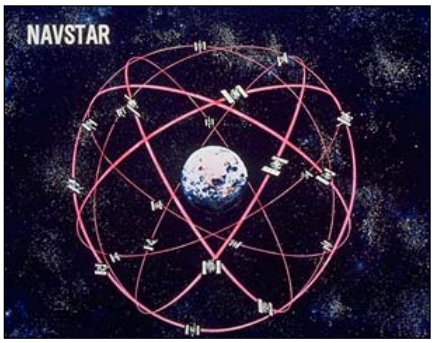
What is GPS?

- GPS: Global Positioning System is a worldwide radio-navigation system formed from a constellation of 25 satellites (space vehicles) and their ground stations.

- Uses the principle of triangulation and time-of-arrival of satellite signals to determine the location of a GPS receiver



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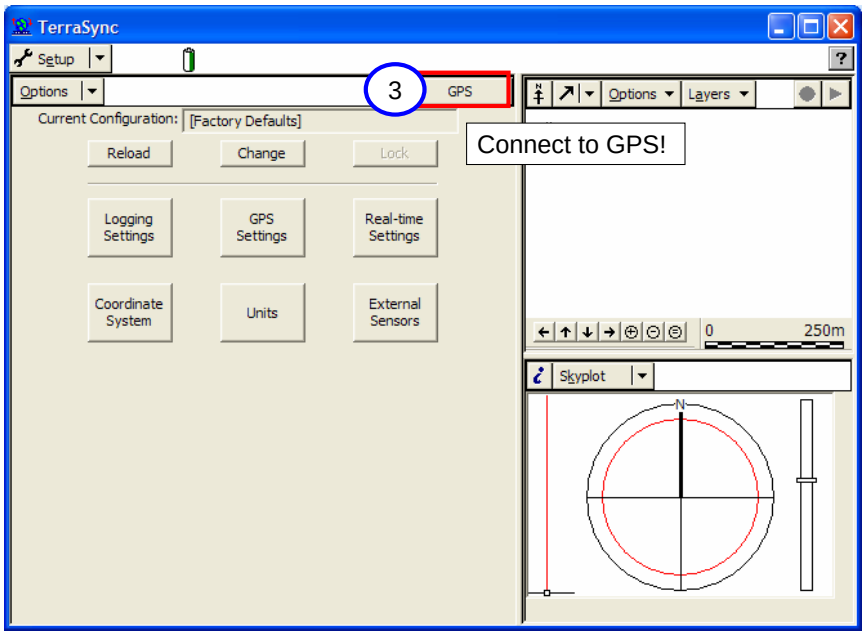
TerraSync Interface



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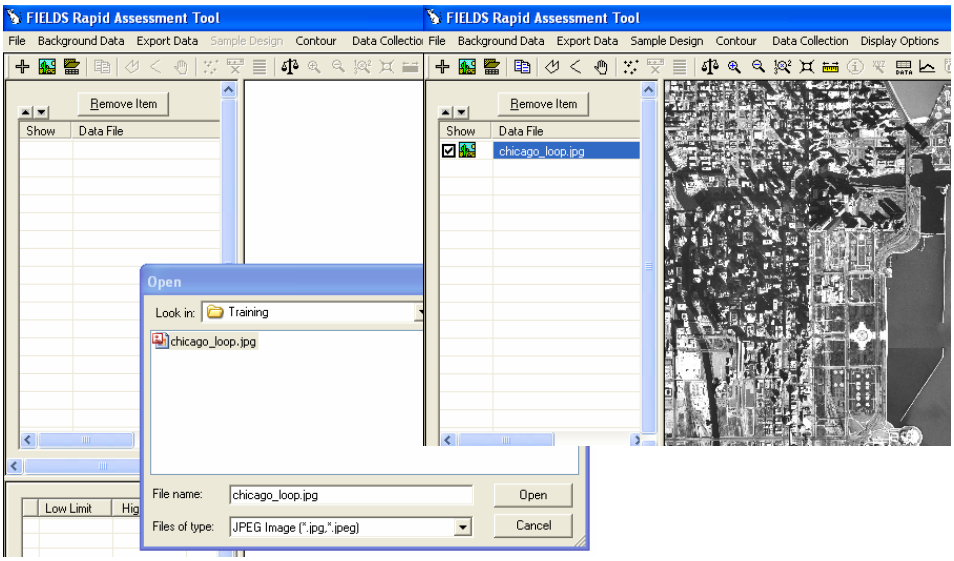
Data Collection
Acquiring background layers



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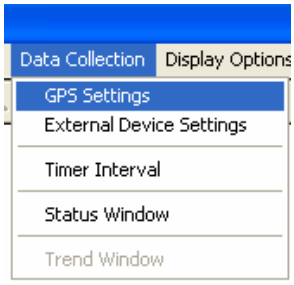
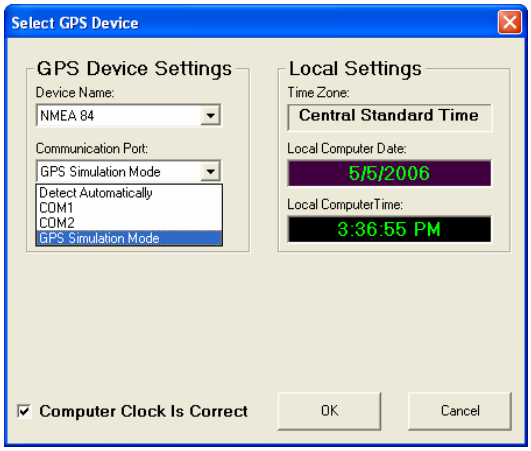
Data Collection
GPS Setup





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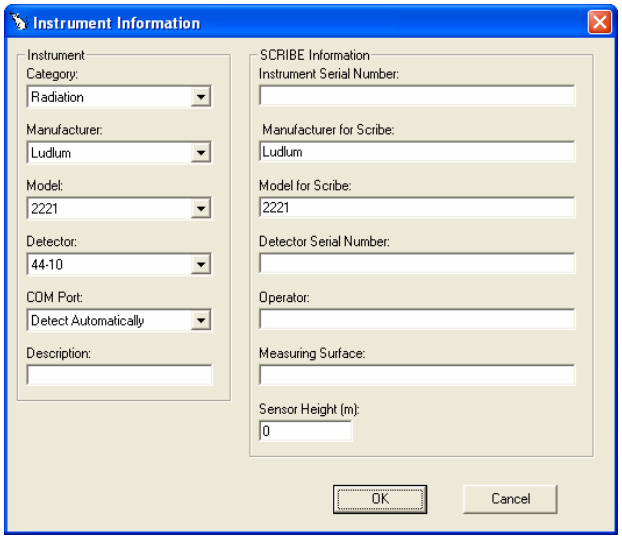
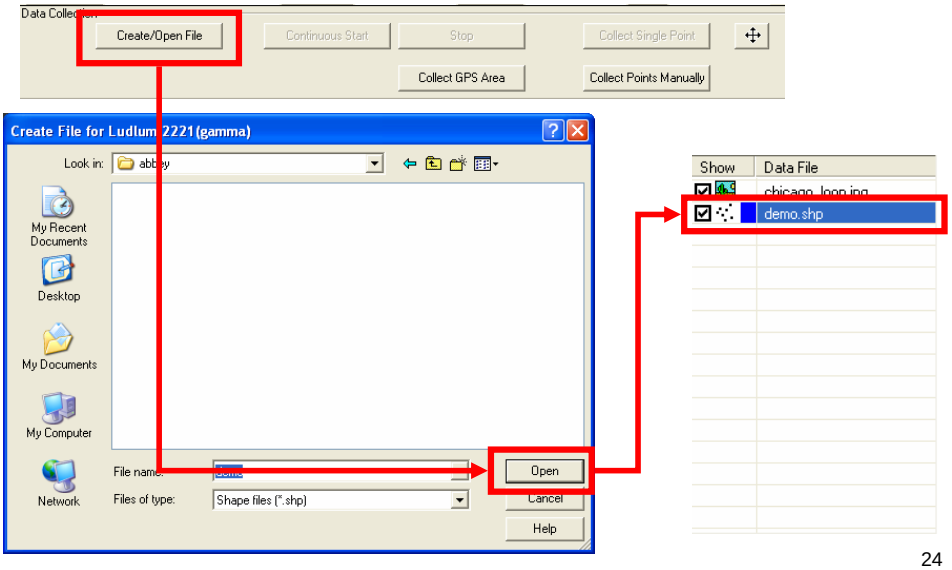
Data Collection
Adding a Device



Data Collection
Creating/Appending a Shapefile



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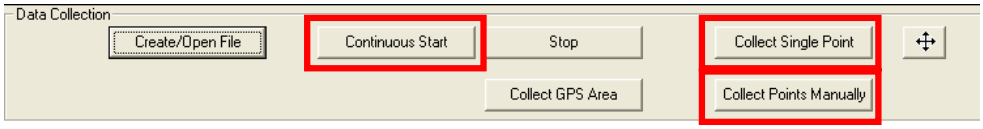
Data Collection



- Have a Choice of type of data collection:
  - Collect GPS Area
  - Continuous
  - Single Point
  - Manual

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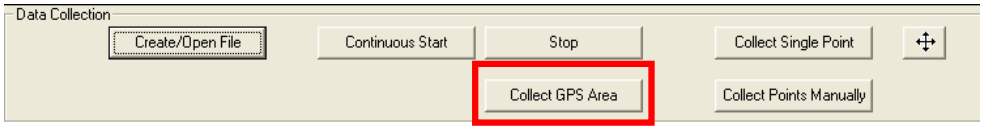
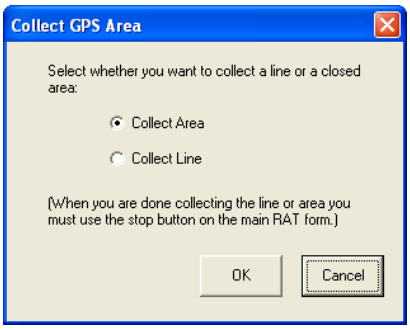
Collect GPS Area



- Line
- Area
  - Sample Design
  - Define hot spots
  - Site boundary



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XRF Sampling
(single point sampling)

X-Ray Fluorescence (**XRF**) testing
- is used to estimate the amount of a variety of heavy metals such as lead that exist in soil or in paint on houses.

The FIELDS team has been involved in the deployment evaluation of XRF devices.

R.A.T. supports the storage of the data values that the XRF produces and their spatial analysis.

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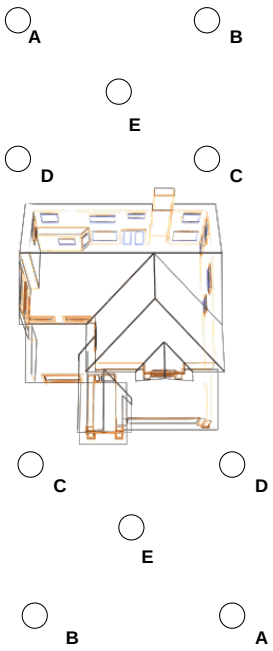
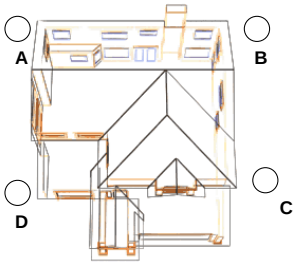
Composite



FIELDS Process for

XRF Sampling

Drip Zone



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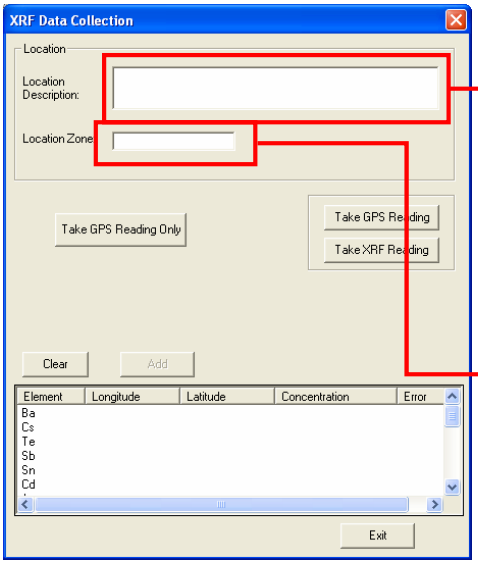
Data Collection

Single point data collection – XRF Reading



- House#_Backyard, Frontyard, or Dripzone
- Example: 345_Backyard

- Discrete: D_A, B, C, D, or E
- Composite: C_E
- Precision: P_1, 2, 3, 4, 5, 6
- In Situ: I_A, B, C, D, E_1, 2, or 3
  - Example: I_C_3

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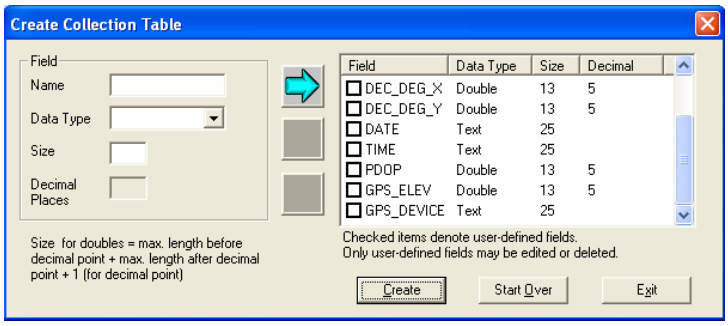
Manual Data Collection



- Data Type:
  - Text: entering a qualitative description (dry, saturated)
  - Integer: values are whole numbers
  - Double: allows you to enter decimal values
- Size:
  - number of text or numerical characters that you want to be able to enter e.g. 2= 99, 3 = RAT
  - **Note** Double: Add 1 for decimal point
- Decimal Places:
  - set the number of decimal places to be entered (when Double is selected as a data type)

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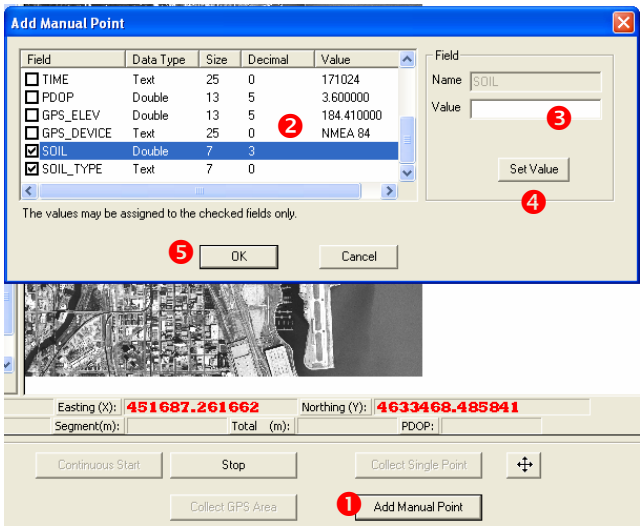
Manual Data Collection



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Data Analysis
using GIS tools In RAT

Topics –

I. Statistics

III. Trend Analysis

IV. Data Estimation using Contour Grids

V. Data Merging

VI. Advanced Analysis

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Data Analysis

- Systematic examination or manipulation of data in order to discover new information or draw conclusions from it
- Some questions-
  - Are the data values evenly distributed or skewed?
  - How does the data change over time?
  - Are certain data values clustered geographically?

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Statistics

- RAT calculates summary statistics for point or grid data layers
- Point data – calculates for all data in the RESULTS database field.
- Grid data – calculates for all pixel data values

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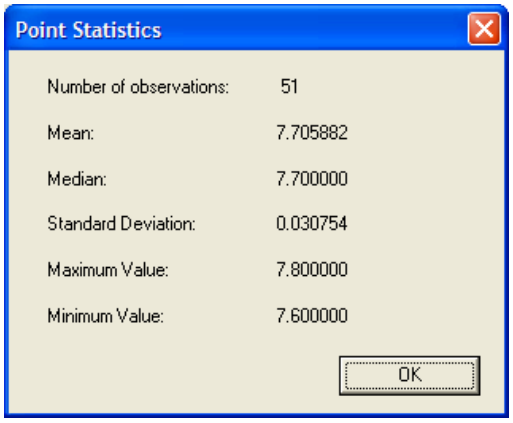
Statistics
Example Output



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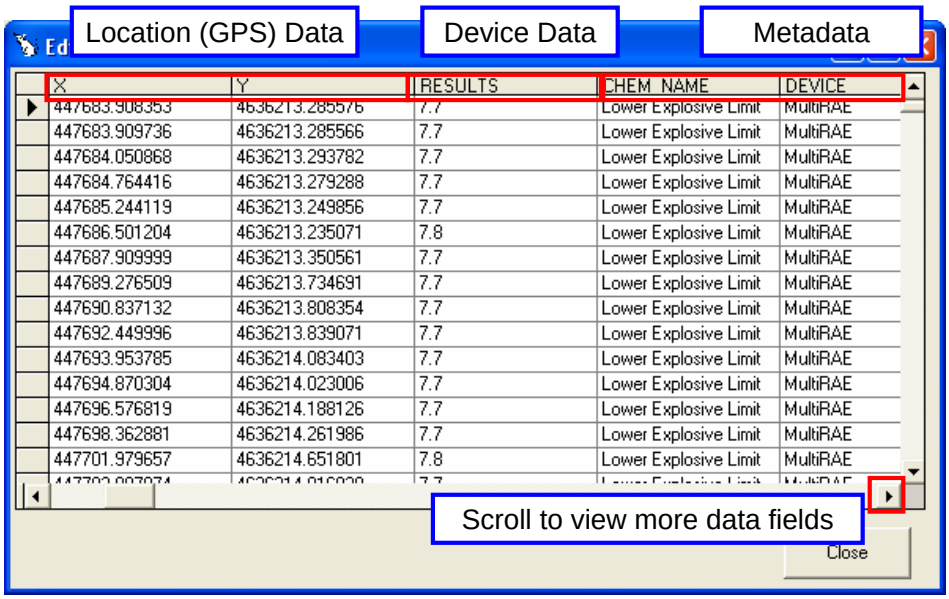
Explain what each one means.

Viewing Data Tables



X	Y	RESULTS	CHEM_NAME	DEVICE
447683.908353	4636213.285576	7.7	Lower Explosive Limit	MultiRAE
447683.909736	4636213.285566	7.7	Lower Explosive Limit	MultiRAE
447684.050868	4636213.293782	7.7	Lower Explosive Limit	MultiRAE
447684.764416	4636213.279288	7.7	Lower Explosive Limit	MultiRAE
447685.244119	4636213.249856	7.7	Lower Explosive Limit	MultiRAE
447686.501204	4636213.235071	7.8	Lower Explosive Limit	MultiRAE
447687.909999	4636213.350561	7.7	Lower Explosive Limit	MultiRAE
447689.276509	4636213.734691	7.7	Lower Explosive Limit	MultiRAE
447690.837132	4636213.808354	7.7	Lower Explosive Limit	MultiRAE
447692.449996	4636213.839071	7.7	Lower Explosive Limit	MultiRAE
447693.953785	4636214.083403	7.7	Lower Explosive Limit	MultiRAE
447694.870304	4636214.023006	7.7	Lower Explosive Limit	MultiRAE
447696.576819	4636214.188126	7.7	Lower Explosive Limit	MultiRAE
447698.362881	4636214.261986	7.7	Lower Explosive Limit	MultiRAE
447701.979657	4636214.651801	7.8	Lower Explosive Limit	MultiRAE

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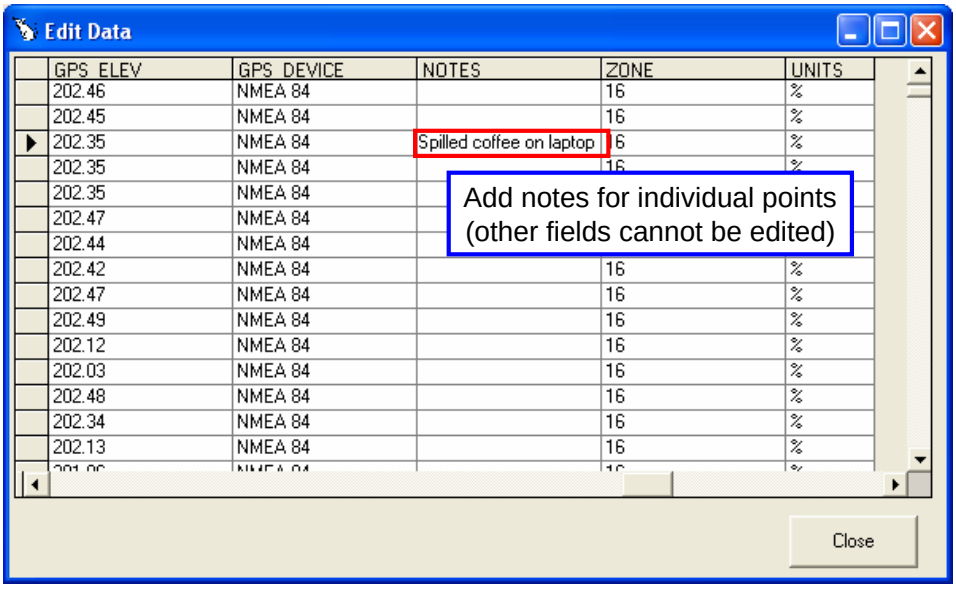
Editing Data Tables



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Trend Window

- View collected data values on a line graph during data collection
- Access analysis functions and histograms from the window
- Visualize the results vs. Time

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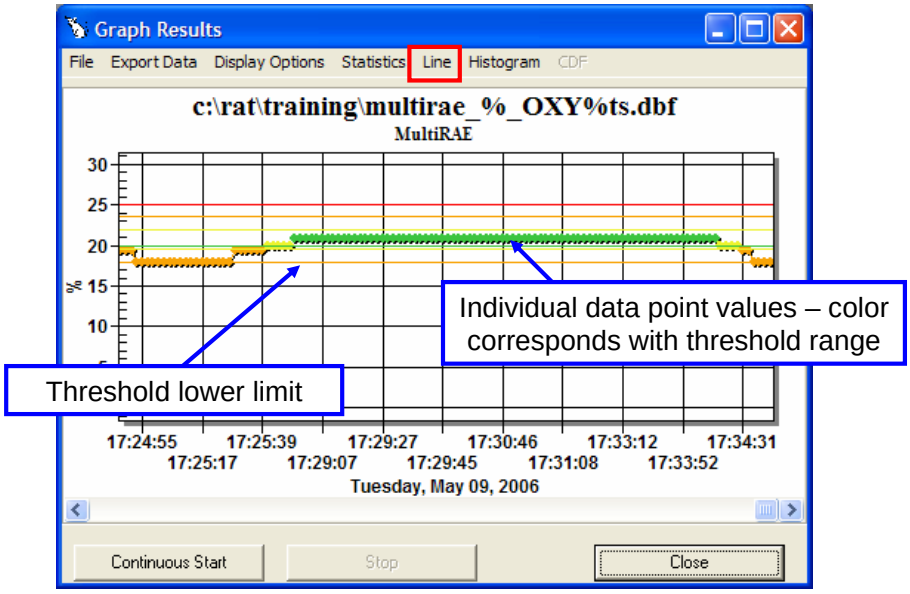
Line View


Graph Results
File
Export Data
Display Options
Statistics
Line
Histogram
CDF
c:\rat\training\multirae_%_OXY%ts.dbf
MultiRAE
30
25
20
%
15
10
17:24:55
17:25:17
17:25:39
17:29:07
17:29:27
17:29:45
17:30:46
17:31:08
17:33:12
17:33:52
17:34:31
Tuesday, May 09, 2006
Continuous Start
Stop
Close
Individual data point values – color corresponds with threshold range
Threshold lower limit

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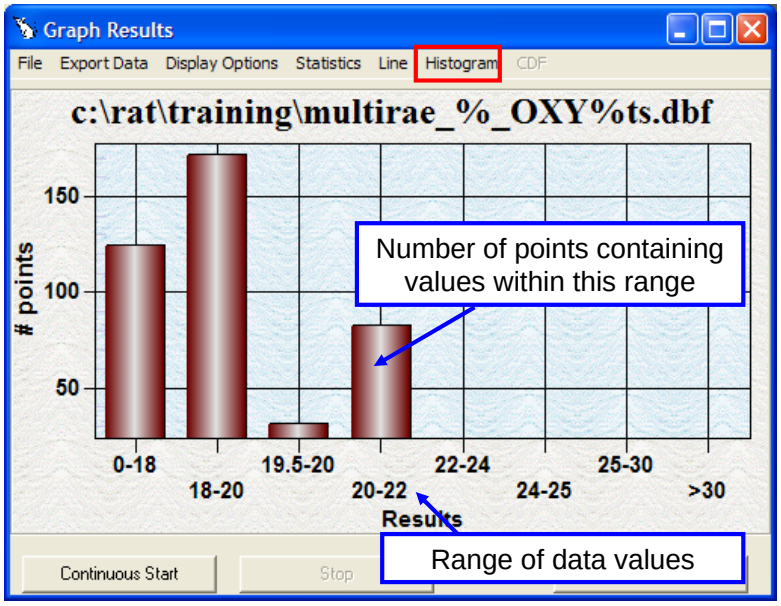
Histogram View



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Contouring

- Create first approximation interpolation of the collected data points.
- Interpolation-
  - Create a grid of estimated values for unsampled locations surrounding your collected points.
  - R.A.T. uses a natural neighbor algorithm
  - Aids in the visualization of contaminant plumes
  - Helps to design a sample design by identifying areas of concern.

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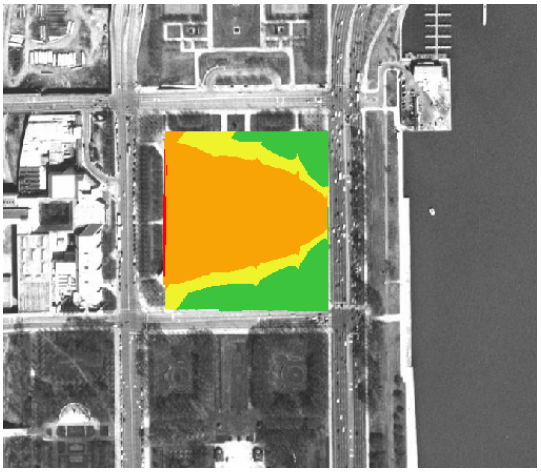
Classify Interpolations
(apply thresholds)

	Low Limit	High Limit	Color
1	0.000000	18.000000	
2	18.000000	19.500000	
3	19.500000	20.000000	
4	20.000000	22.000000	
5	22.000000	23.500000	
6	23.500000	25.000000	
7	25.000000	30.000000	



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Going back to the GIS overview- viewing data with different classification schemes allows you to see different patterns in the data (geovisualization)

Merging Data

- Multiple Shapefiles can be combined together into one
- Advantages
  - Combine data from morning and afternoon data collection for organization
  - View statistics, trend window, or apply contouring on merged Shapefiles to gather new information from the collected data

Advanced Analysis & Modeling

- After data has been collected and stored using R.A.T. it can be brought into other GIS packages for further analysis.
- **F/S Plus** is a stand-alone, 2D/3D data display and analytical tool that was also created by FIELDS
  - free download at http://www.tiem.utk.edu/~fields/
  - Using more complex GIS tools allows for more advanced analysis and visualization of the data.

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RAT Field Applications

- Pre-Deployments
- Exercises
- Emergency Response
- Site Assessments
- Outside partnerships

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Predeployments

All-Star Game Deployment
July 12, 2005

- The EPA was asked to participate in the preparedness for an unknown emergency response situation at the baseball All-Star game in Detroit, MI
- RAT was utilized by the external monitoring team to perform mobile monitoring before and during all of the all-star game events.
- The data from A RAE device, a Draeger device, a Ludlum device and a GPS receiver were combined using a Panasonic Tough book to create a single spatially indexed data set.
- The external monitoring team was able to monitor areas between stationary radiation detectors using a Kawasaki Mule.

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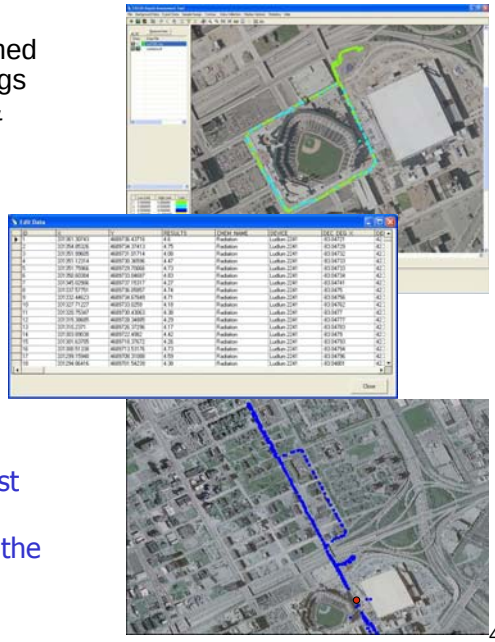
All-Star Game Conclusions

- The four wheel drive ATV performed data collection runs where readings were taken every second for air & radiation.

- Each run was analyzed for data spikes immediately after the run was complete. Small elevations were detected, but no high or dangerous values were found.

- The wireless network gave the command center real-time monitoring capabilities for the east side of the stadium, but wireless interference limited the ability of the network on the west side.



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Emergency Response

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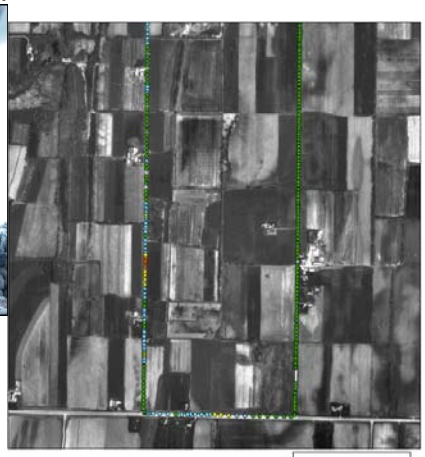
Tire Fire

Watertown, WI



- **July 19, 2005, a tire fire broke out at the Watertown Tire and Recycling facility.**
- **The fire engulfed the main building and the large tire stockpile in the rear of the facility.**
- **The fire was reported to be out on Monday, July 25, 2005.**

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Cincinnati Styrene Response
Cincinnati, OH

"I have used the maps to brief incident commanders and mayors who are making evaluation decisions."

– Steve Renninger (OSC)

- **RAT maps can be used in the field to view the data as it is being collected**
- **The maps can also be saved as .jpeg images for easy transfer of visual data from the field to all interested parties.**
- **The maps can also be used in reports and presentations after the situation has been resolved.**

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Alternative Plastics Fire

Greendale, IN

- July 7, 2005 - Greendale Fire Department responded to a fire at a plastics manufacturing plant.
- July 7th, EPA (Steve Renninger Lead OSC) began perimeter air monitoring using START resources, RAT software, and multiRAE devices.
- A Shelter area was defined and safety zones were established and updated based on the collected air monitoring data.
- The fire was controlled on July 8th and EPA air monitoring continued until the end of July 9th.

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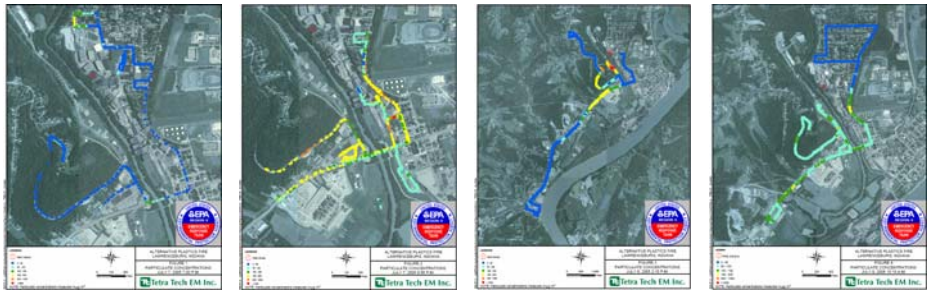
Alternative Plastics Fire

Greendale, IN



July 7th 7:20 PM | July 7th 9:55pm | July 8th 2:15pm | July 9th 10:10 am

- **Multiple Runs using an ATV with a GPS and monitoring devices were made though out the day.**
- **The data from these runs were made into maps that were valuable aides for the Unified Command.**

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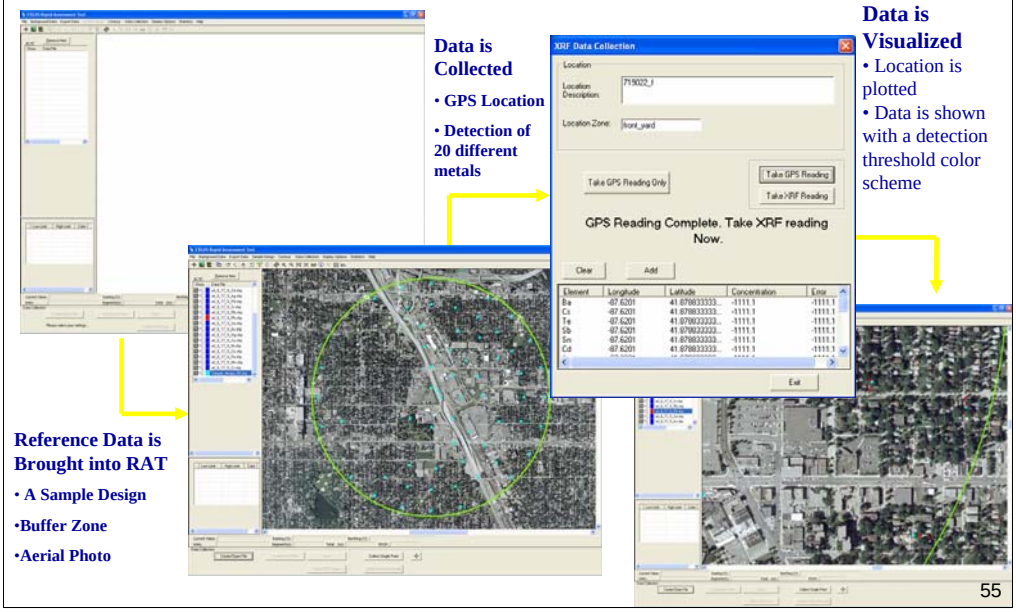
Site Assessments

CMC Industrial Chemical Contamination

Minneapolis, MN
Secondary Sample Design for Site Characterization



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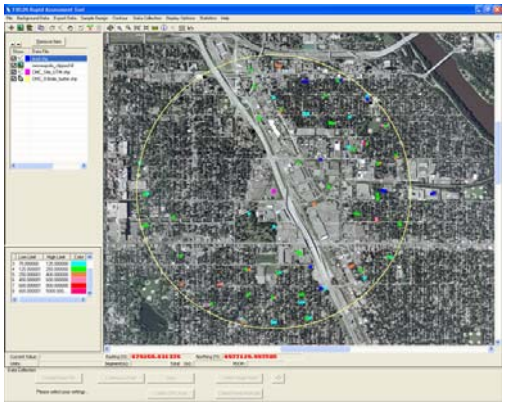
CMC Industrial Chemical Contamination

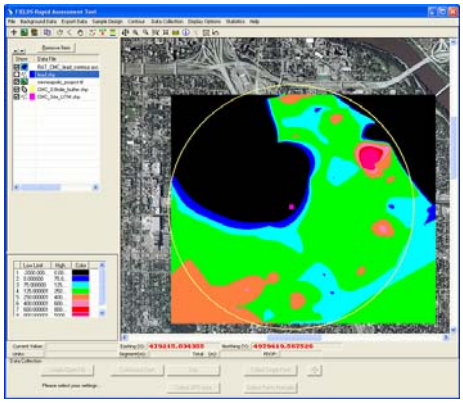
Minneapolis, MN
Secondary Sample Design for Site Characterization

(Lead readings for all samples)



- The Rapid Assessment Tools saves each XRF element reading into a separate file so individual elements can be easily viewed later using ArcView or other Mapping Software

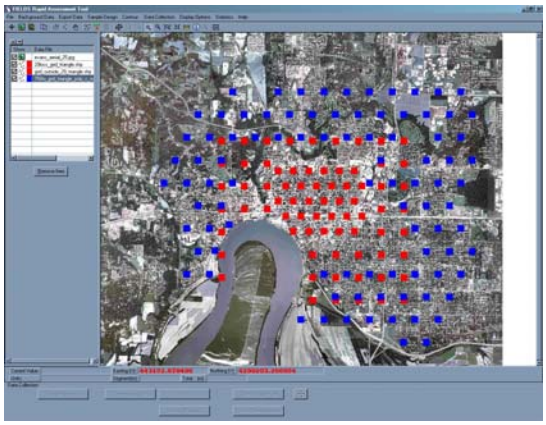
(Contour of lead readings for all samples)

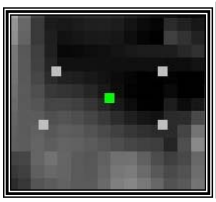


- RAT can create a contour on the fly for the elements that exist in all the samples

Jacobsville Residential
Sampling Design

Primary and secondary sampling plans can be created in RAT allowing for defendable refocusing of sampling efforts in the field.





- **The red represents the phase 1 sampling positions**
- **the blue represents the phase 2 positions.**

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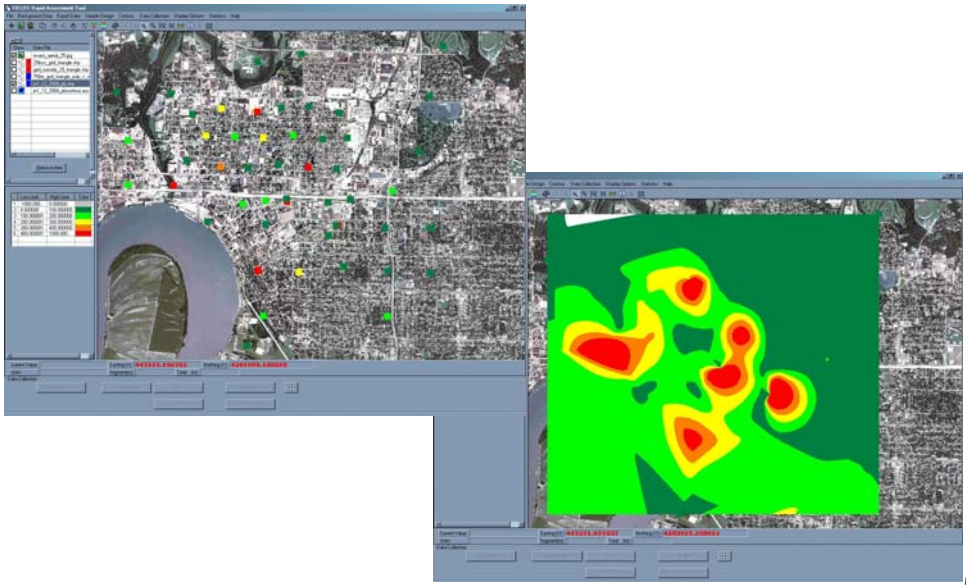
Jacobsville Residential
Phase 1 Collection (2004)



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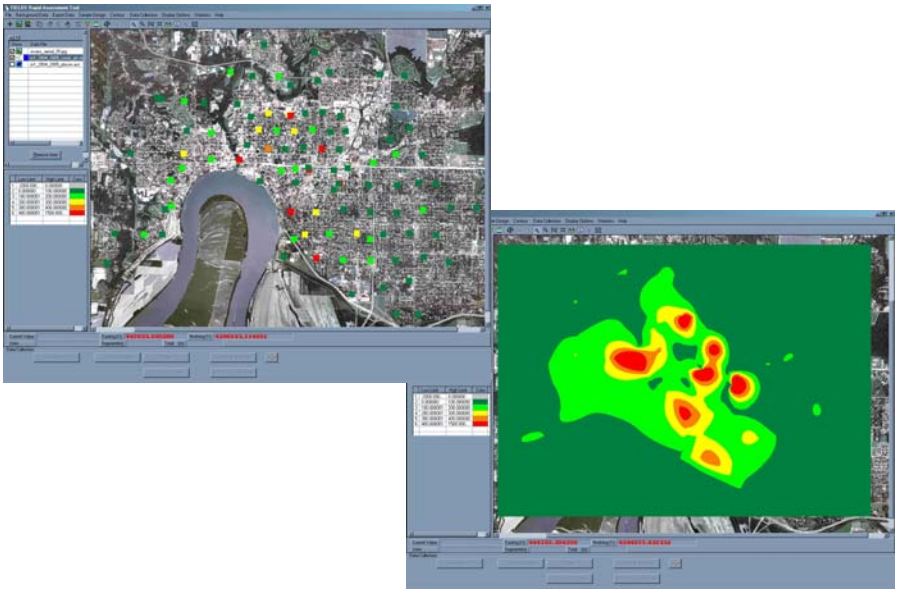
Jacobsville Neighborhood
Phase 2 Collection (2005)



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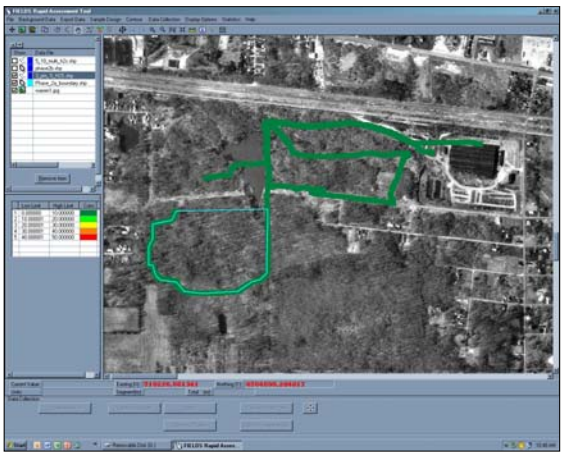
Warren Recycling
Initial Perimeter Monitoring

- Monitoring was initially used to determine if high H_2S concentrations exist above 1 ppm on the perimeters of existing landfills and ponds using a ppm MultiRae.
- Boundaries were then delineated to be used for sample designs using the Interscan ppb analyzer.



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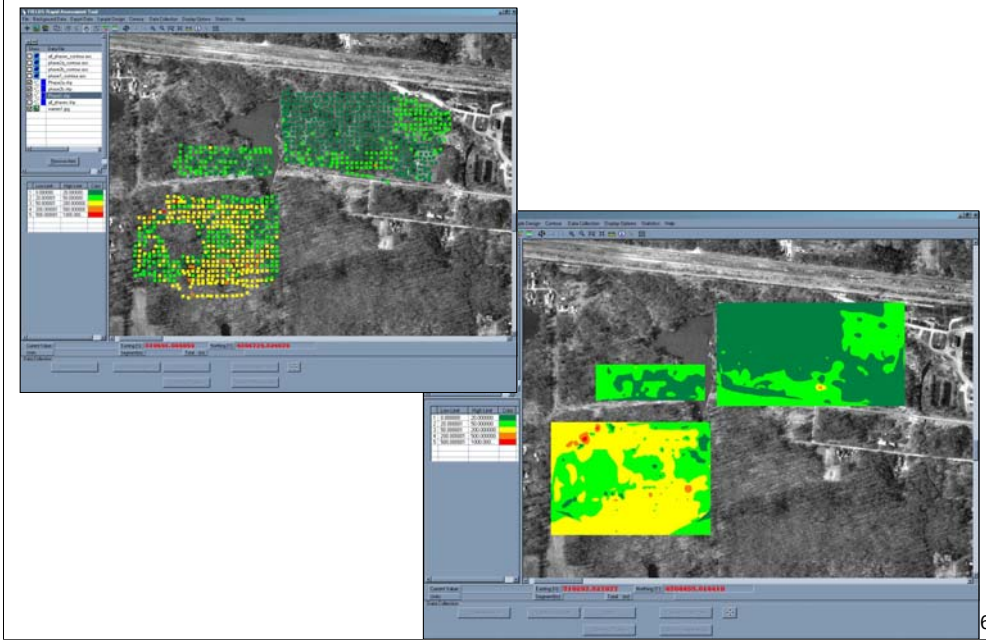
Warren Recycling

Collected Data Points



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Inter-Agency Partnerships

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EPA/U.S. Customs & Border Protection & OSHA

- Partnership Goals
  - develop and strengthen interagency relations for conducting rapid chemical and radiological assessments
  - utilize and leverage agency assets to achieve the need of each agency, and
  - improve national security by optimizing the resources offered by each agency.

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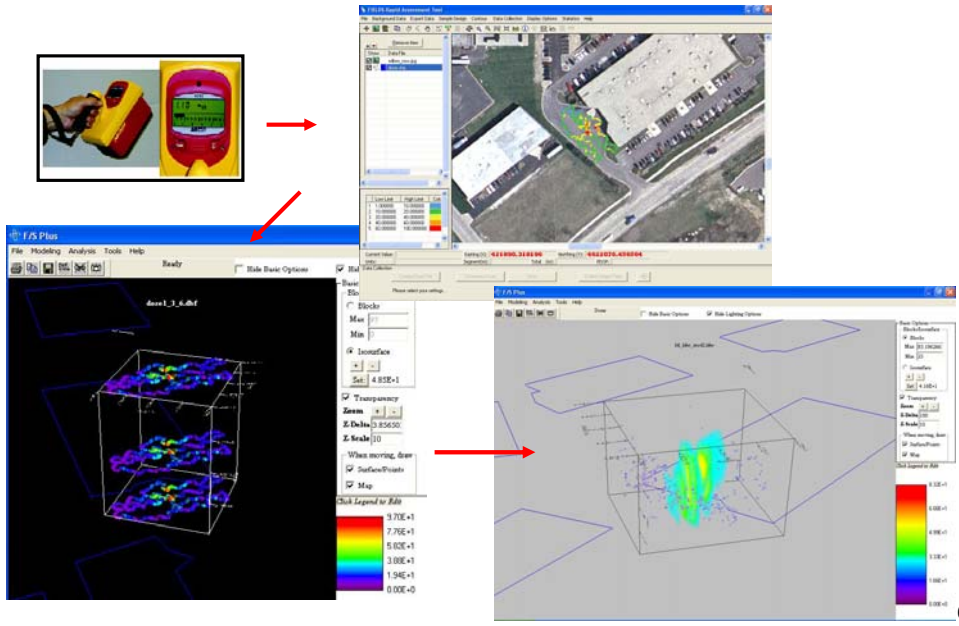
The United States Customs and Border Protection uses an array of radiation detection equipment to intercept contraband, conduct vehicle and cargo inspections, and screen people. These technologies include x-ray systems, radionuclides, accelerators, and neutron activation systems. Although the systems used by Customs cause little or no radiation exposure to their operators, Customs still provides training to the inspectors who use them and conducts rigid evaluations to verify that the equipment is optimized for the job and meets the strictest safety parameters. Part of the evaluation process includes a radiological footprint associated with the technology. This information is used by Customs personnel to establish radiation-restricted and exclusion areas for the equipment. Radiation systems provide Customs with a vital, technological edge in carrying out its mission. New systems are appearing regularly expand their "reach" and sensitivity for national security. These systems also provide new levels of safety for the people who operate them and those who may be exposed to their effects. Customs sees a strong potential for the EPA *RAT* tool to 1) quickly characterize existing systems to ensure safety measures and maintenance efforts are adequate, and 2) rapidly assess and implement the latest technologies to improve national security.

The National Institute for Occupational Safety and Health conducts research and makes recommendations for the prevention of work-related injury and illness. NIOSH is part of the Centers for Disease Control and Prevention (CDC) in the Department of Health and Human Services. This agency has extensive experience conducting field evaluations and assessments and is identified in the National Response Plan Worker Health and Safety Annex as the agency to conduct complex exposure assessments. NIOSH personnel will use the EPA *RAT* tool to provide and independent assessment of the various Customs screening technologies. Their experience, expertise, and feedback will help EPA improve the *RAT* tool as well as strengthen Customs occupational safety program.

Customs Demo
3D Data Visualization & Contouring
Using F/S Plus



Thank You for Coming!

Any Questions?

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Thank You

After viewing the links to additional resources, please complete our online feedback form.

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