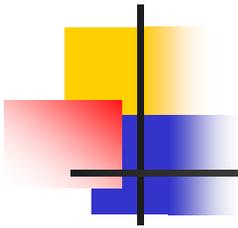


Using VOCDat to Validate and Process Air Toxics Data

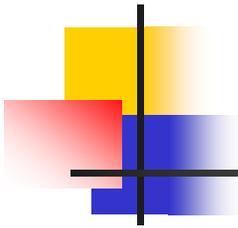
Steven G. Brown
Hilary R. Hafner
Sonoma Technology, Inc.
Petaluma, CA

14th Annual National Air Quality Systems Conference
Clearwater, FL
May 24-28, 2004



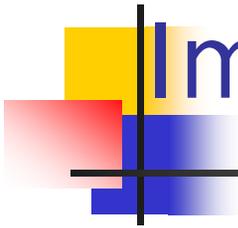
Outline of Presentation

- Overview: What and Why
- After Obtaining Data From Labs:
 - Using VOCDat for processing, validating data
 - How to import & export data
 - Validation examples and ideas
 - How to handle aethalometer data too!
- New: Precision Report
- Other New Additions to VOCDat
- What Other Features Would Be Helpful?



VOCDat: How Did We Get Here?

- Originally developed for Photochemical Assessment Monitoring Stations (PAMS) VOC data
- Later adapted to easily
 - Acquire data from AQS/AIRS
 - Process data into AQS/AIRS format
 - View and validate data before submitting to AQS!
- Easily applied to other data sets, including air toxics



Importance of Data Validation

“The purpose of data validation is to detect and then verify any data values that may not represent actual air quality conditions at the sampling station.”*

**Without proper validation
before analysis, erroneous
conclusions may be drawn!**

* U.S. EPA 1984, Sec. 2.0.3, p. 10

What is VOCDat?

- VOCDat is a Windows-based, menu-driven program used to
 - Import various data formats
 - Display VOC, toxics, and PM data
 - Validate the data
 - Begin data analyses
 - Export the data into EPA AQS format



VOCDat

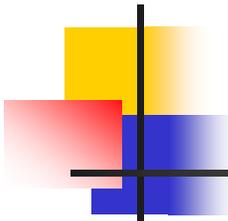
Version 2.33

Volatile Organic Compound Data
Display, Quality Control, and Analysis

Developed as part of:
NARSTO-Northeast
Modifications funded by:
US EPA OAQPS

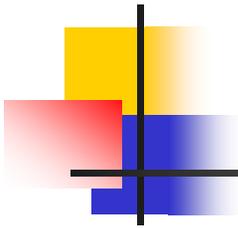
For technical support contact:
Sonoma Technology, Inc.
1360 Redwood Way, Suite C
Petaluma, CA 94954
(707)665-9900

Copyright © 1995-2002
Electric Power Research Institute
All Rights Reserved



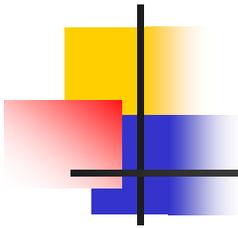
VOCDat Features (1 of 2)

- Import and export AQS AMP370 (old AIRS) format
- Import and export AQS R2 format
- Import flexible format ASCII files
- Import Turbochrome and TotalChrome (auto-GC) formats
- Export formats suitable for other software (such as spreadsheets or databases)
- Edit data QC codes on screen (keeps a log of changes)
- Prepare graphical displays of time series, scatter, and fingerprint plots



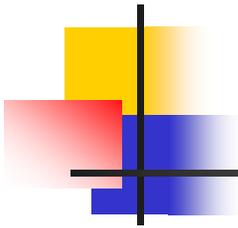
VOCDat Features (2 of 2)

- Provides summary statistics
- Allows species list (selectable) customization
- Allows screening criteria customization
- Creates “weighted” data (using reactivity or risk)
- Calculates species group sums including paraffins, olefins, aromatics, unidentified, carbonyls
- Facilitates AQS precision report preparation and formatting



How VOCDat Works

- VOCDat needs to know what species to expect in the data file
 - Species.txt defines abbreviations, method codes, units
 - Several species lists available
 - Only species in the list will be exported
- VOCDat allows for supplemental data handling
 - Species2.txt allows use of meteorological and criteria pollutant data in validation
 - These are not exported into AQS



From the Beginning:

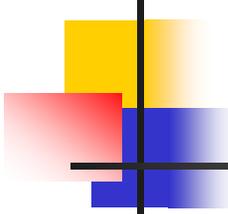
- Acquire toxics data from lab, then what?
- Select TO-15 method species list
 - List may be modified to accommodate other species
- Check format of data
 - Select one of a number of specific formats
 - Work with labs to get data in useful format
 - Know anyone who likes Access? Use them for lab data!
- Import into VOCDat

Importing ASCII Files

The screenshot shows a dialog box titled "ASCII Import" with the following sections and options:

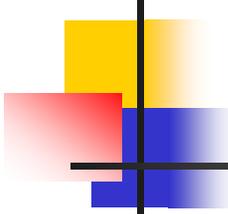
- Field Delimiters:** Radio buttons for Commas, Spaces, Tabs, and Pipes.
- Header Records:** Two spin boxes, both set to the value 1. The first is labeled "Number of Header Records:" and the second is labeled "Header Record Containing Species IDs:".
- Species IDs:** Radio buttons for AIRs Parameter Codes and Abbreviations.
- QC Codes:** Radio buttons for None, Follow Each Species, and Follow All Species.
- Date/Time:** Radio buttons for Combined and Separate Fields. Below these are two spin boxes: "Date Field:" set to 1 and "Time Field:" set to 1.

At the bottom of the dialog are three buttons: "Note", "OK", and "Cancel".



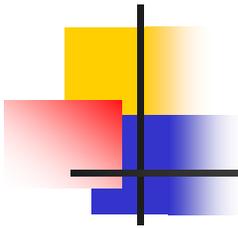
Validation Approach I

- Understand the pollutant sources, lifetimes, temporal behavior, etc. (use tools such as “cheat sheets”)
- Understand site location, sampling and analysis techniques
- Inspect summary statistics and apply screening criteria



Validation Approach II

- Inspect all species
 - Time series plots
 - Scatter plots (internal consistency)
- Inspect every sample
 - Fingerprint plots (in elution order)
- Flag data and document modifications
- Prepare data for AQS



Making Validation Easier

- Once data is VOCDat ready, easy to validate!
- With EPA, STI has developed “cheat sheets” for the primary 18 HAPs
 - Available soon at www.ladco.org/toxics.html
 - Also useful in analysis!
- Easily generated simple graphs allow for quick validation
- User’s guide, data validation workshop useful for examples and ideas
http://www.sonomatechdata.com/sti_workbooks

Sample HAPs Validation Sheet (1 of 2)

Formaldehyde

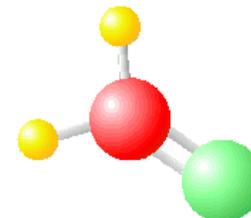
Synonyms: BFV; formalin; formalith; formic aldehyde; Formol; FYDE; HCHO; HOCH; karsan; lysoform; Methanal; methyl aldehyde; methylene glycol; methylene oxide; oxomethylene

Molecular formula: CH₂O

CAS Registry #: 50-00-0

AIRS parameter code: 43502

Chemical group: Carbonyl



Summary: Formaldehyde is created by the oxidation of gas-phase hydrocarbons. Formaldehyde concentrations exhibit diurnal and seasonal variability because Formaldehyde photochemical production is a function of sunlight. Although it is also rapidly removed from the atmosphere via photochemical reaction, continuous production from the oxidation of methane and nonmethane hydrocarbons keep formaldehyde at concentrations above detection.

Reactivity	High	Lifetime	Hours
Background¹ conc.	0.2 ± 0.07 µg/m ³ (from 1980-2002)	Spatial scale	Local, subregional, regional
Molecular Weight	30.03	Conversion factor²	1 ppb = 1.35 µg/m ³
Sources	Key photochemical reaction product. Also produced by power plants, manufacturing facilities, incinerators, and automobile exhaust emissions. Used as a chemical intermediate, analytical reagent, concrete and plaster additive, used in cosmetics, disinfectants, fumigants, photography, and wood preservation and particle board products.		
Sinks	Photolysis; reaction with OH		
I in 10⁶ cancer risk:	0.08 µg/m ³ (IRIS, 2003); 0.17 µg/m ³ (CAL EPA, 2002)		
Non-cancer RfC³	3.6 µg/m ³ tier 2 (Axelrad <i>et al.</i> , 1998); 3 µg/m ³ (CAL EPA, 2000)		
Minimum Detection Limits (Pilot Cities)	Average: 0.05 µg/m ³ Range: 0.001-0.1 µg/m ³		

Regulations since 1990: Direct regulations include: wood furniture manufacturing in 1995 (33,000 tons/yr); off-site waste operations in 1996 (43,000 tons/yr); and pulp and paper production (155,000 tons/yr)⁴. Also, Maximum Achievable Control Technology (MACT) reductions on other VOCs will also indirectly reduce formaldehyde production (see Benzene, 1,3-butadiene).

Sample HAPs Validation Sheet (2 of 2)

Data Validation Guidelines for Formaldehyde

Table of expected temporal and spatial behavior

<i>Temporal or Spatial Scale</i>	<i>Expect Variability?</i>	<i>Behavior/explanation</i>	<i>Action</i>
Diurnal (time of day)	Urban-yes Rural-likely	Photochemical production from other VOCs is highest during the day	Check for midday-afternoon peak in concentrations
Day of week	Possible, but not likely	If VOC concentrations are significantly lower on weekends, production may be lowered	Check for lower concentrations of formaldehyde on weekends
Seasonal	Yes-highest during the summer	Increased production with increased sunlight	Check for differences in average concentrations as a function of season
Annual	Possible	May correlate with decreased concentrations of VOCs	Check for interannual differences, correlate with total non-methane organic carbon concentrations
Urban/Rural	Yes-likely higher urban	Urban has automobile emissions and industry; rural sites may be influenced by local forests	Check for urban/rural differences. Determine sources in each environment
Regional	Yes-highest in urban centers	Same as urban/rural	Same as urban/rural
Global	Yes	Same as urban/rural	Same as urban/rural

Possible interspecies correlations: Acetaldehyde should show the strongest correlation with formaldehyde. May also correlate reasonable well with benzene, 1,3-butadiene, and total nonmethane organic carbon.

Typical Urban Concentrations: 1999 from historical database: 2.0-5.1 $\mu\text{g}/\text{m}^3$
2001-2002 from pilot city study: 1.8-3.8 $\mu\text{g}/\text{m}^3$

VOCDat Screening Checks (1 of 3)

Abundant Species Concentrations

Abundant Species Concentrations

Sample fails screening if:

<input checked="" type="checkbox"/>	1.	acety	concentration is less than	0.5	ppbC
<input checked="" type="checkbox"/>	2.	ebenz	concentration is less than	0.5	ppbC
<input checked="" type="checkbox"/>	3.	benz	concentration is less than	0.5	ppbC
<input checked="" type="checkbox"/>	4.	tol	concentration is less than	0.5	ppbC
<input checked="" type="checkbox"/>	5.	mpxyl	concentration is less than	0.5	ppbC
<input checked="" type="checkbox"/>	6.	oxyl	concentration is less than	0.5	ppbC
<input checked="" type="checkbox"/>	7.	124tmb	concentration is less than	0.5	ppbC
<input type="checkbox"/>	8.	benz	concentration is less than	0.5	ppbC
<input type="checkbox"/>	9.	benz	concentration is less than	0.5	ppbC
<input type="checkbox"/>	10.	benz	concentration is less than	0.5	ppbC

Concentration Comparisons

Concentration Variability

OK Cancel

VOCDat Screening Checks (2 of 3)

Abundant Species Comparisons

Concentration Comparisons

Sample fails screening if:

<input checked="" type="checkbox"/>	1.	acety	concentration is greater than	benz	concentration
<input checked="" type="checkbox"/>	2.	benz	concentration is greater than	tol	concentration
<input type="checkbox"/>	3.	oxyl	concentration is greater than		concentration
<input checked="" type="checkbox"/>	4.	oxyl	concentration is greater than	mpxyl	concentration
<input type="checkbox"/>	5.	benz	concentration is greater than		concentration
<input checked="" type="checkbox"/>	6.		concentration is greater than		concentration
<input type="checkbox"/>	7.		concentration is greater than		concentration
<input type="checkbox"/>	8.		concentration is less than	1000	ppbC and
		uidvoc	concentration is greater than	200	ppbC
<input type="checkbox"/>	9.		concentration is less than	2	ppbC and
		benz	concentration is greater than	2	ppbC
<input type="checkbox"/>	10.	uidvoc	fraction of		
			is greater than	50	percent

Abundant Species Concentrations

Concentration Variability

OK Cancel

VOCDat Screening Checks (3 of 3)

Abundant
Species
Concentration
Variability

Concentration Variability

Sample fails screening if:

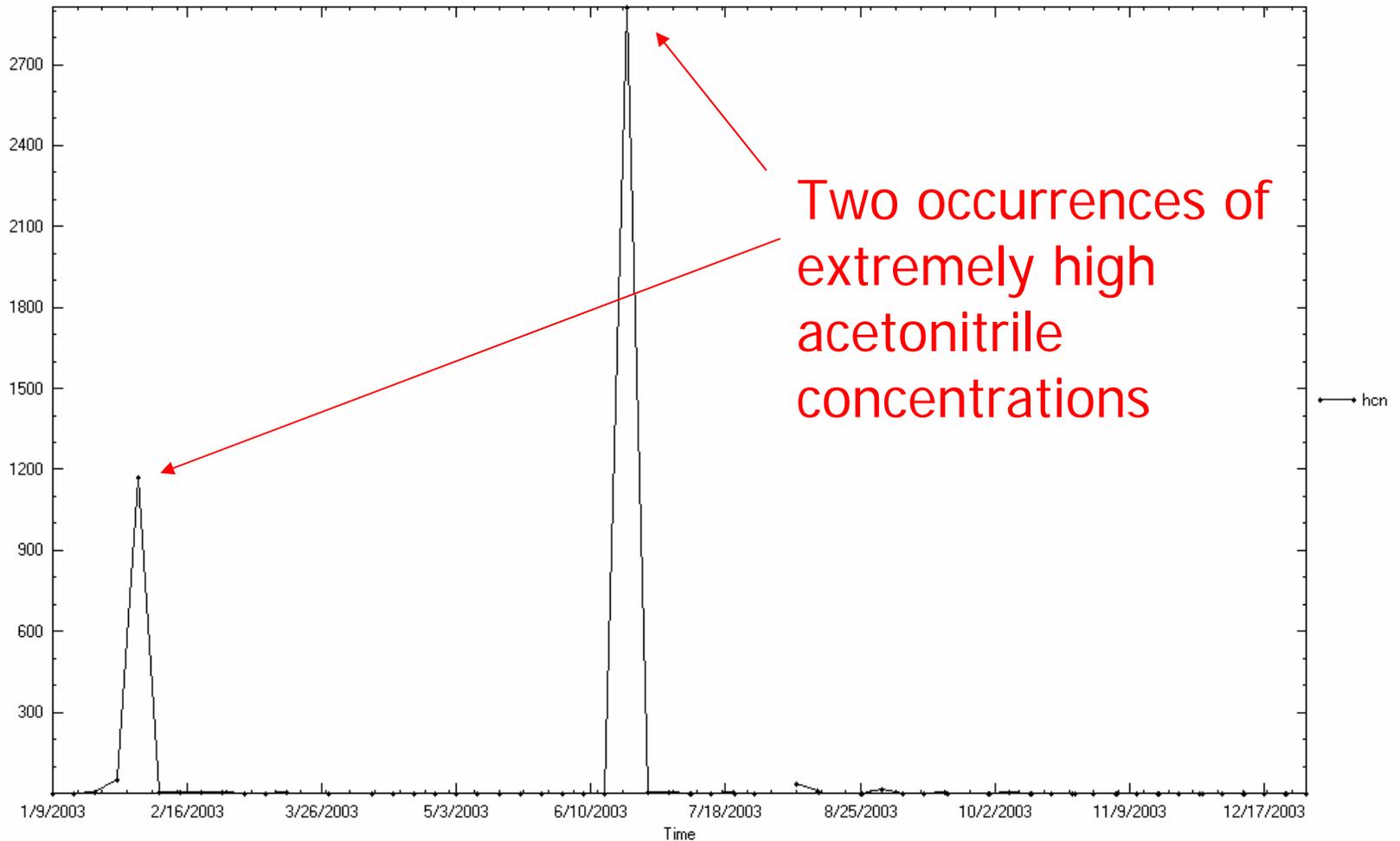
	The concentration of	is more than	times the standard deviation of the mean
<input checked="" type="checkbox"/> 1.	acety	3	
<input checked="" type="checkbox"/> 2.	13but	3	
<input checked="" type="checkbox"/> 3.	mtbe	3	
<input checked="" type="checkbox"/> 4.	benz	3	
<input checked="" type="checkbox"/> 5.	tol	3	
<input checked="" type="checkbox"/> 6.	mpxyl	3	
<input checked="" type="checkbox"/> 7.	styr	3	
<input checked="" type="checkbox"/> 8.	124tmb	3	
<input type="checkbox"/> 9.	benz	3	
<input type="checkbox"/> 10.	benz	3	

Abundant Species Concentrations

Concentration Comparisons

OK Cancel

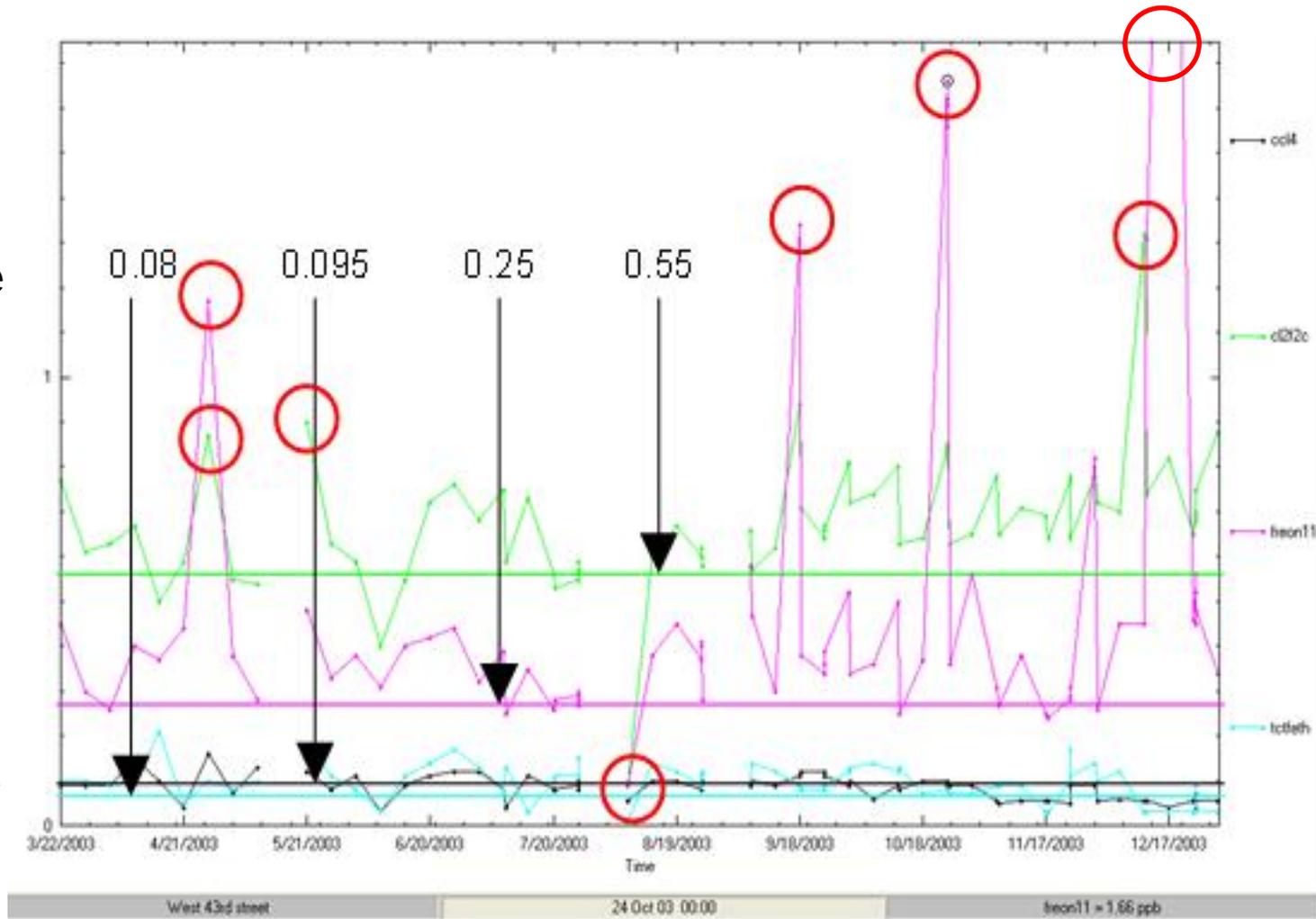
Example: Extreme Events



Example: Concentrations Exceeding Background

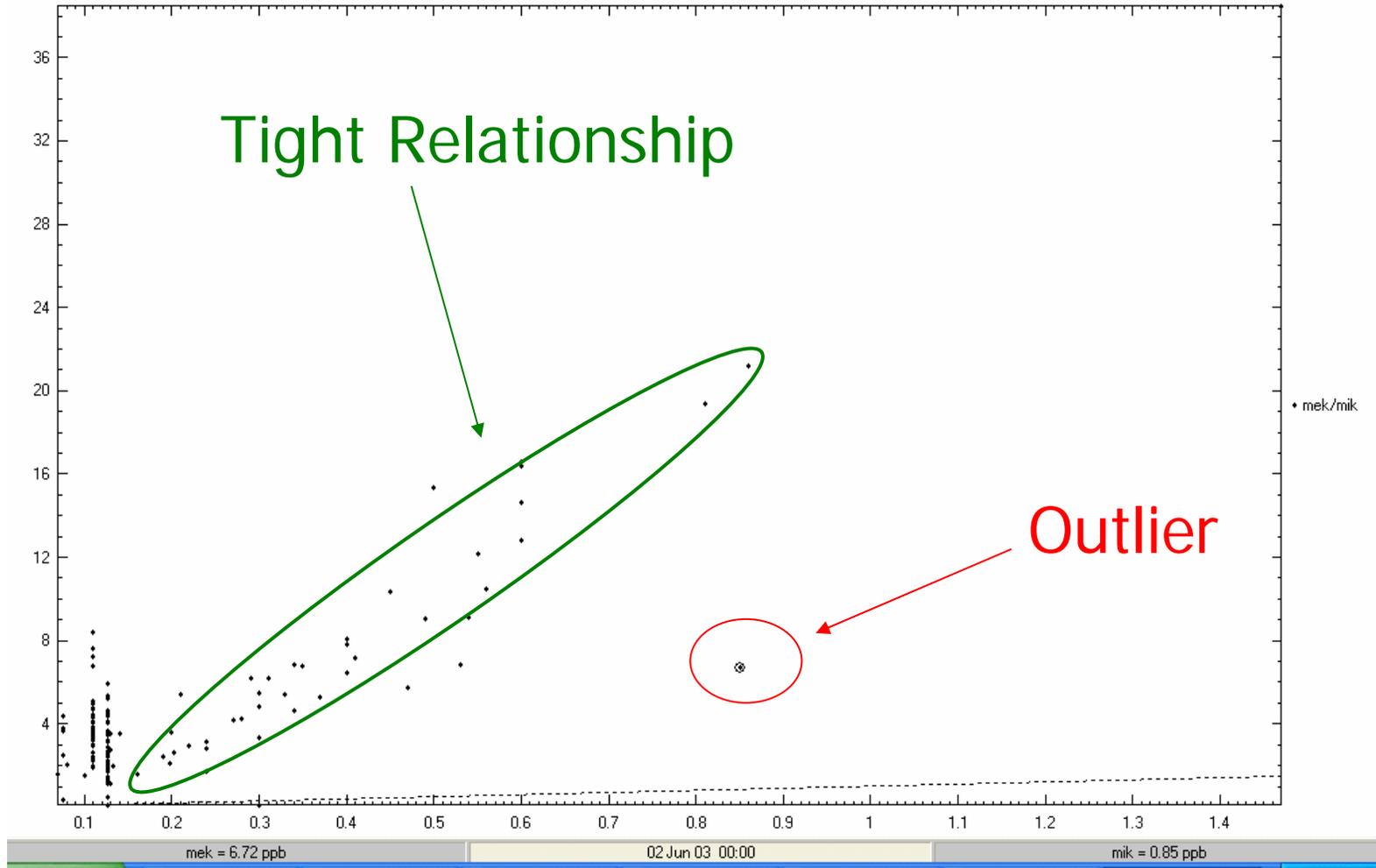
These CFCs are regional/global, and should not be significantly different than background.

Spikes in concentrations may be from nearby sources or analytical error



Example: Species Relationships

Methyl Ethyl Ketone

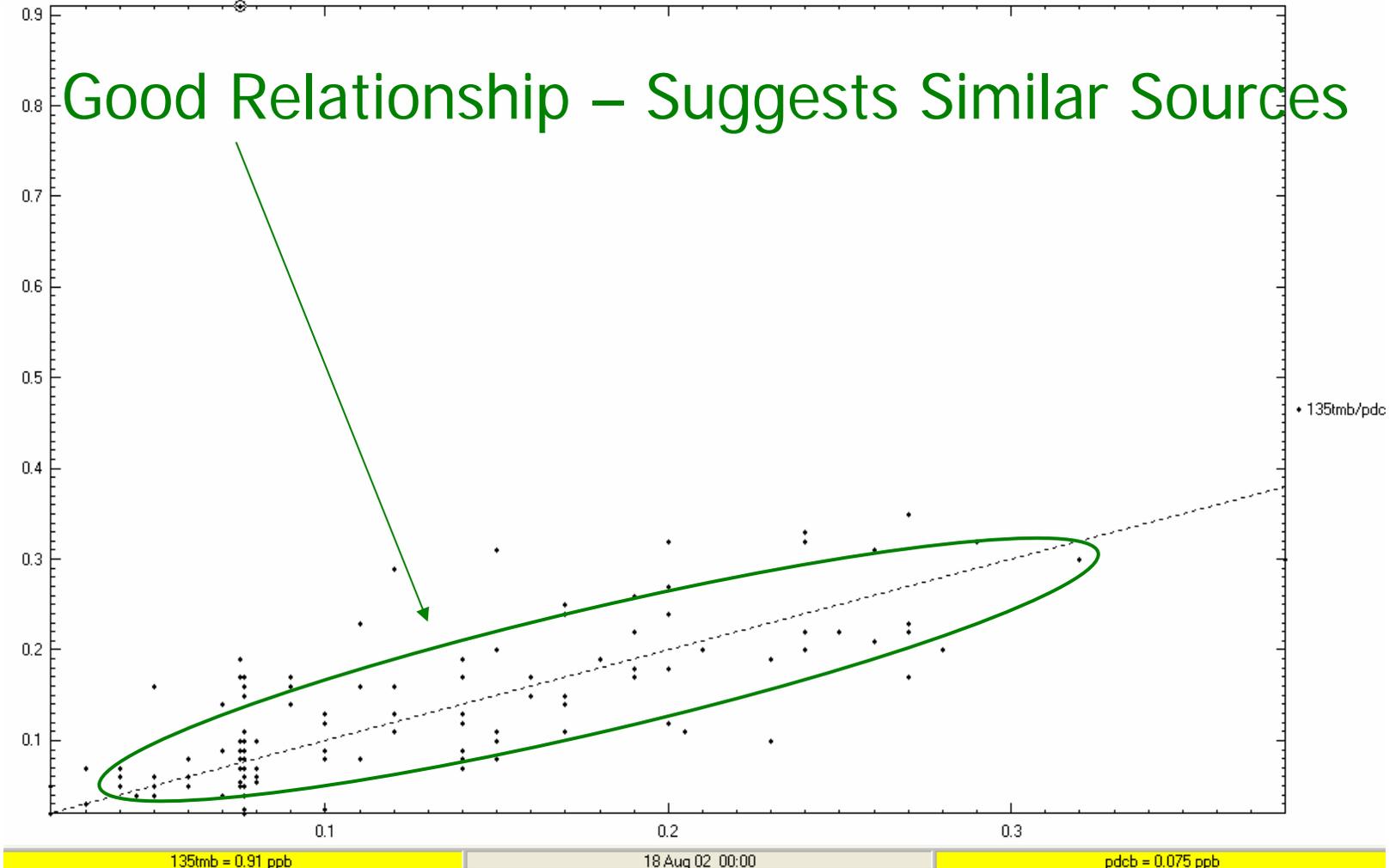


Methyl Isobutyl Ketone

Example: Surprising Relationships

1,3,5-trimethylbenzene

Good Relationship – Suggests Similar Sources



p - dichlorobenzene

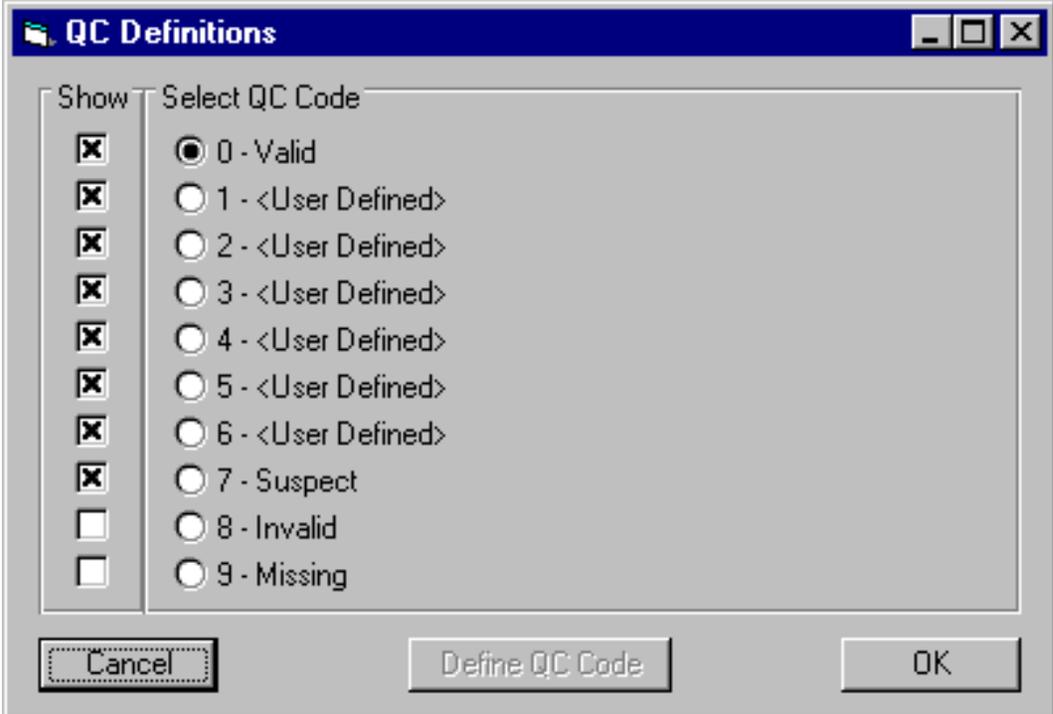
Flagging Suspect/Invalid Data (1 of 2)

Once you identify erroneous data, use the VOCDat toolbar to flag either the entire sample record or a single parameter



Flagging Suspect/Invalid Data (2 of 2)

Assign user-defined codes to indicate the problem

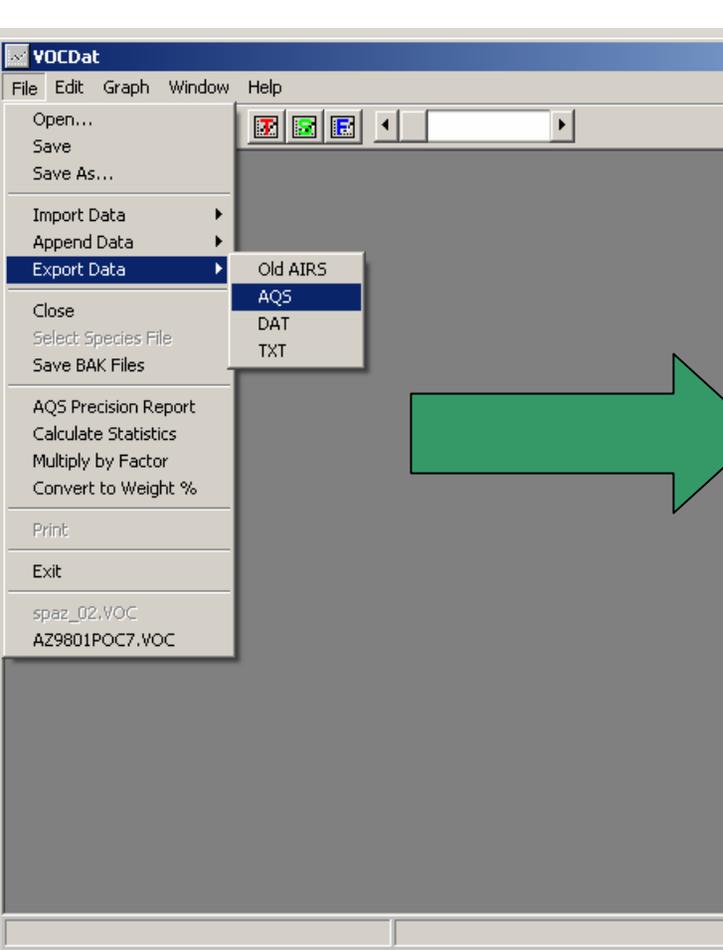


The image shows a dialog box titled "QC Definitions". It has a "Show" column on the left with checkboxes for each QC code, and a "Select QC Code" column on the right with radio buttons. The "Valid" option (code 0) is selected. The "Define QC Code" button is disabled.

Show	Select QC Code
<input checked="" type="checkbox"/>	<input checked="" type="radio"/> 0 - Valid
<input checked="" type="checkbox"/>	<input type="radio"/> 1 - <User Defined>
<input checked="" type="checkbox"/>	<input type="radio"/> 2 - <User Defined>
<input checked="" type="checkbox"/>	<input type="radio"/> 3 - <User Defined>
<input checked="" type="checkbox"/>	<input type="radio"/> 4 - <User Defined>
<input checked="" type="checkbox"/>	<input type="radio"/> 5 - <User Defined>
<input checked="" type="checkbox"/>	<input type="radio"/> 6 - <User Defined>
<input checked="" type="checkbox"/>	<input type="radio"/> 7 - Suspect
<input type="checkbox"/>	<input type="radio"/> 8 - Invalid
<input type="checkbox"/>	<input type="radio"/> 9 - Missing

Buttons: Cancel, Define QC Code, OK

Export into AQS Format I



AIRS Information

AIRS Codes

AIRS Code: State: County: Site:

POC Code:

Method Code: (default)

Action Code:

Time Gaps

Fill Time Gaps

Fill Time Gaps With:

Null Value Reason Code:

Null Data Code (New AIRS):

Species to Output

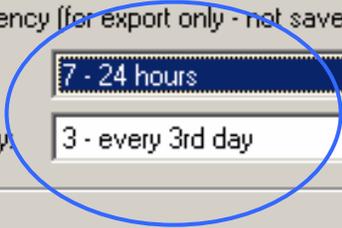
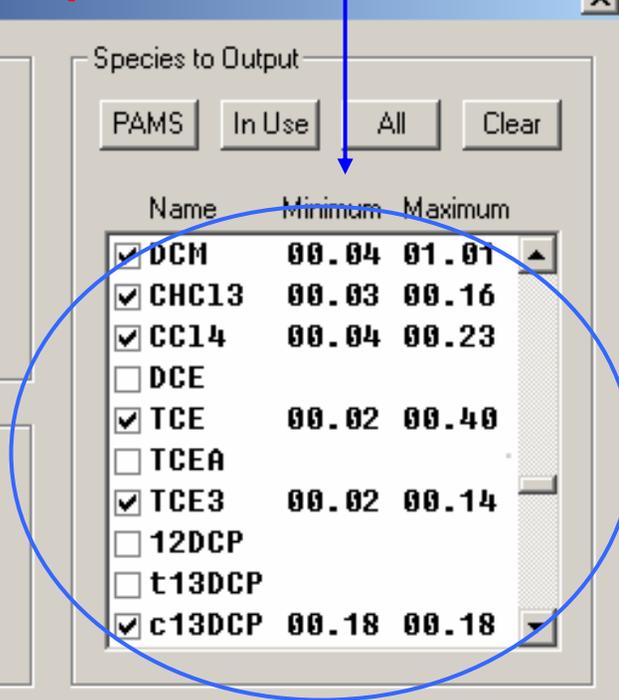
Name	Minimum	Maximum
<input checked="" type="checkbox"/> DCM	00.04	01.01
<input checked="" type="checkbox"/> CHC13	00.03	00.16
<input checked="" type="checkbox"/> CC14	00.04	00.23
<input type="checkbox"/> DCE		
<input checked="" type="checkbox"/> TCE	00.02	00.40
<input type="checkbox"/> TCEA		
<input checked="" type="checkbox"/> TCE3	00.02	00.14
<input type="checkbox"/> 12DCP		
<input type="checkbox"/> t13DCP		
<input checked="" type="checkbox"/> c13DCP	00.18	00.18

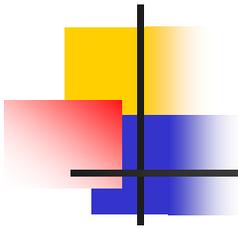
Duration and Frequency (for export only - not saved)

Sample Duration:

Sampling Frequency:

Species Selected



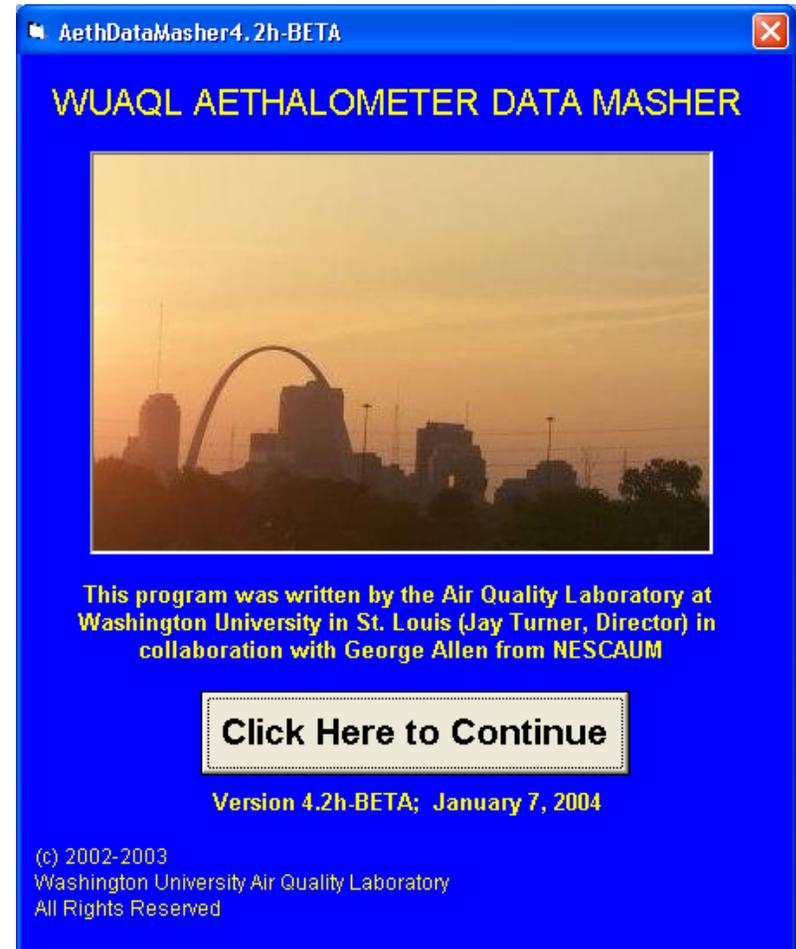


Aethalometer (Black Carbon)

- NATTS sites have aethalometers to monitor black carbon (BC), a marker (not unique!) for diesel particulate matter (DPM)
- What to do with the data?
- “Masher” developed by Jay Turner (Washington University, St Louis)
- Can bring the exported data from the aethalometer directly into the Masher
- Then into VOCDat! Ready for validation and export into AQS format.

Data Masher

- 5-minute or 1-hour averaged data can be input into Masher
- Calculated hourly averages
- Voids hours with $<75\%$ completeness
- Available from Jay Turner:
JRTurner@seas.wustl.edu



AethDataMasher4.2h-BETA

WUAQL AETHALOMETER DATA MASHER



This program was written by the Air Quality Laboratory at Washington University in St. Louis (Jay Turner, Director) in collaboration with George Allen from NESCAUM

[Click Here to Continue](#)

Version 4.2h-BETA; January 7, 2004

(c) 2002-2003
Washington University Air Quality Laboratory
All Rights Reserved

Example Import: Aethalometer Data (1 of 3)

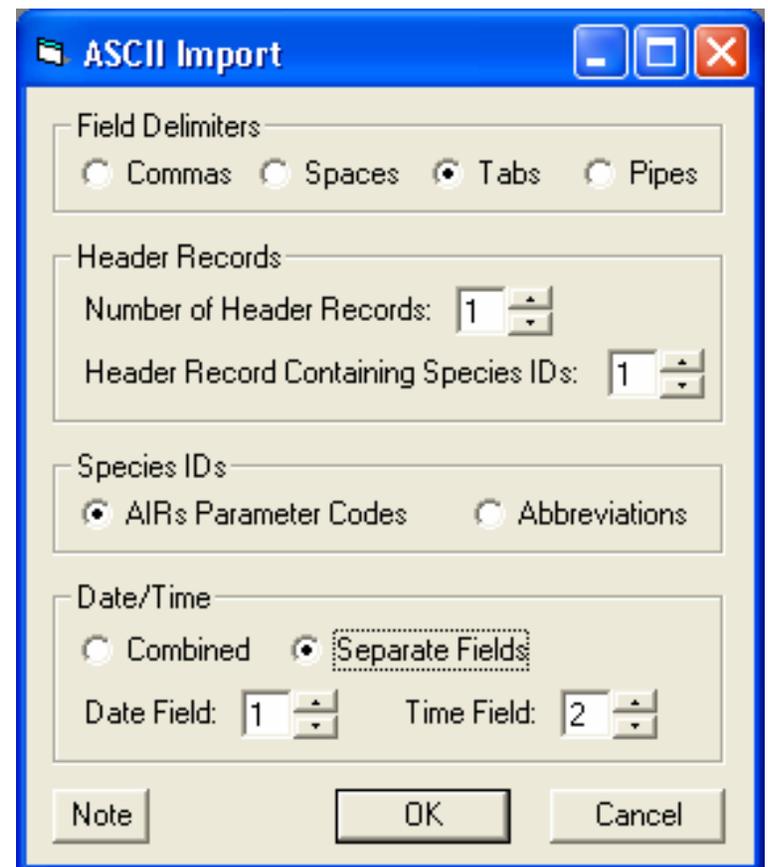
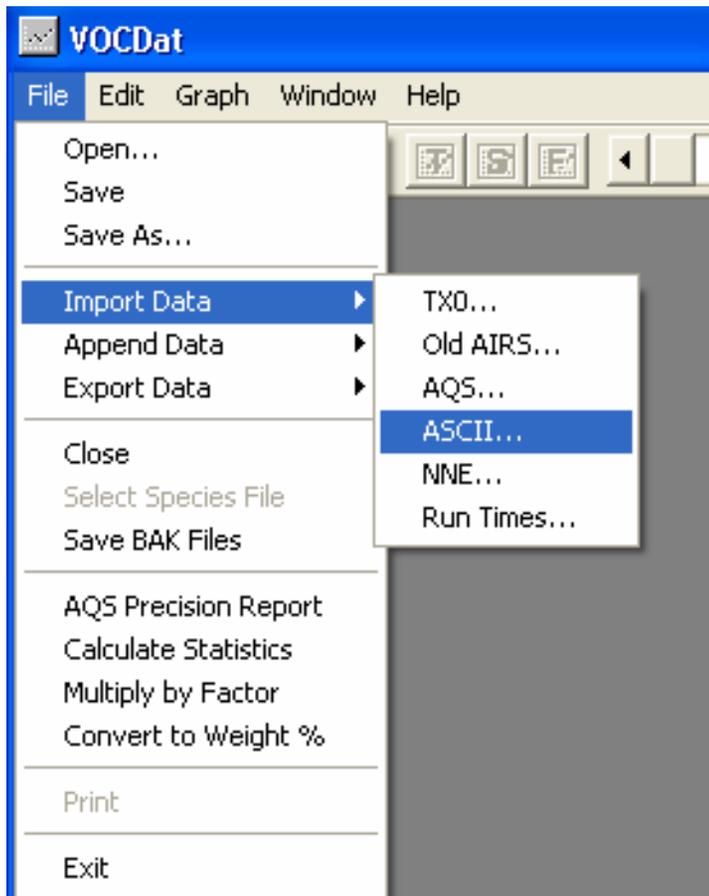
- Data are provided in a comma-separated text file with no header records.
- Save the file as tab-delimited txt (or CSV).

Date	time	84313
8/5/2003	21:00:00	0.251
8/5/2003	22:00:00	0.322
8/5/2003	23:00:00	0.19
8/6/2003	0:00:00	0.149
8/6/2003	1:00:00	0.289
8/6/2003	2:00:00	0.519
8/6/2003	3:00:00	0.316
8/6/2003	4:00:00	0.338
8/6/2003	5:00:00	0.511

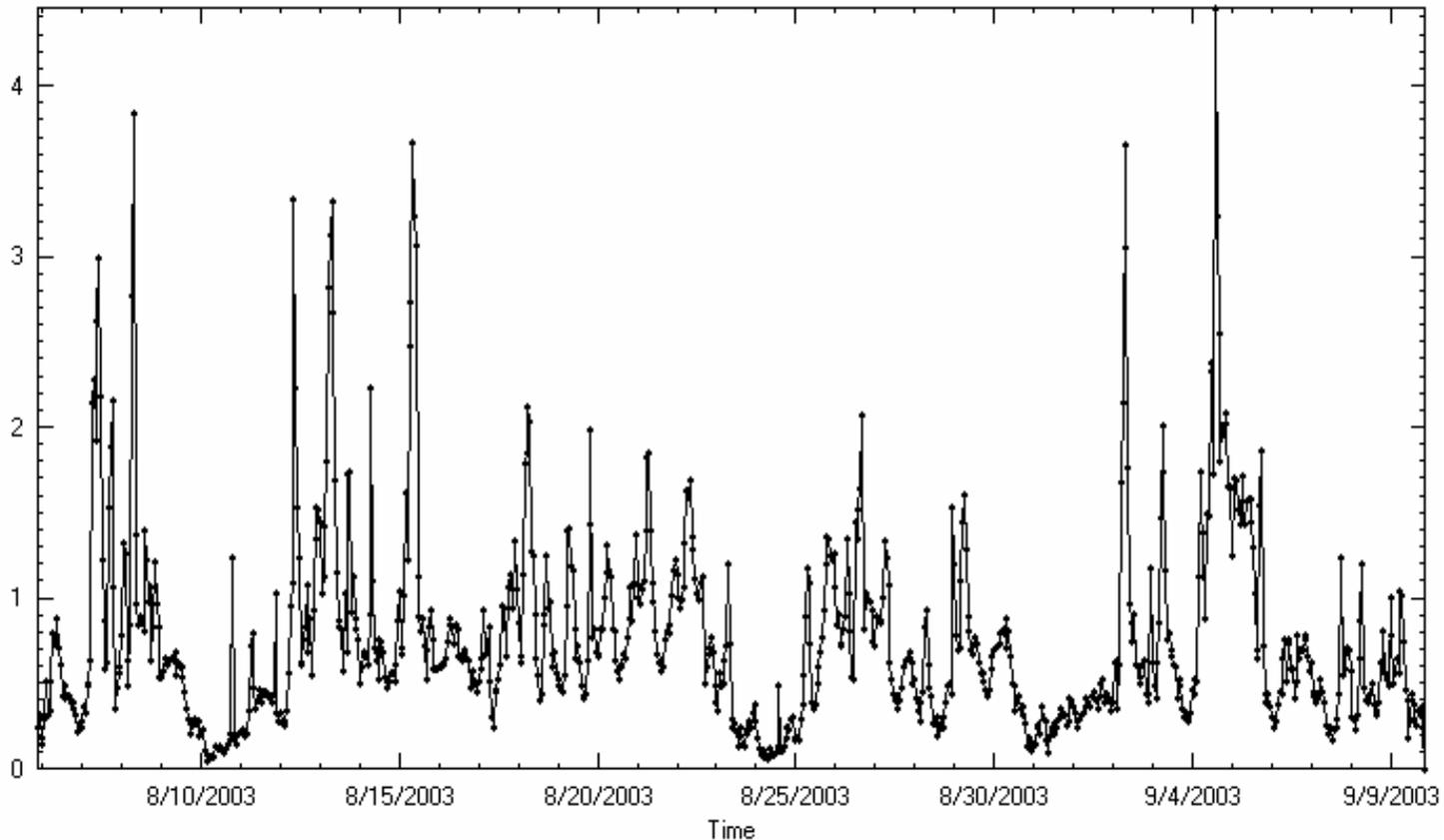
In VOCDat Species file:

84313 Black carbon PM2.5 STP
88313 Black Carbon PM2.5 LC
84313 Black carbon PM2.5 STP
88313 Black Carbon PM2.5 LC

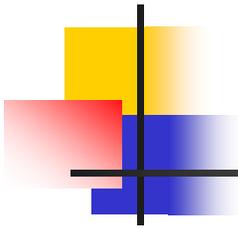
Example Import: Aethalometer Data (2 of 3)



Example Import: Aethalometer Data (3 of 3)



Ready for validation and export into AQS format!



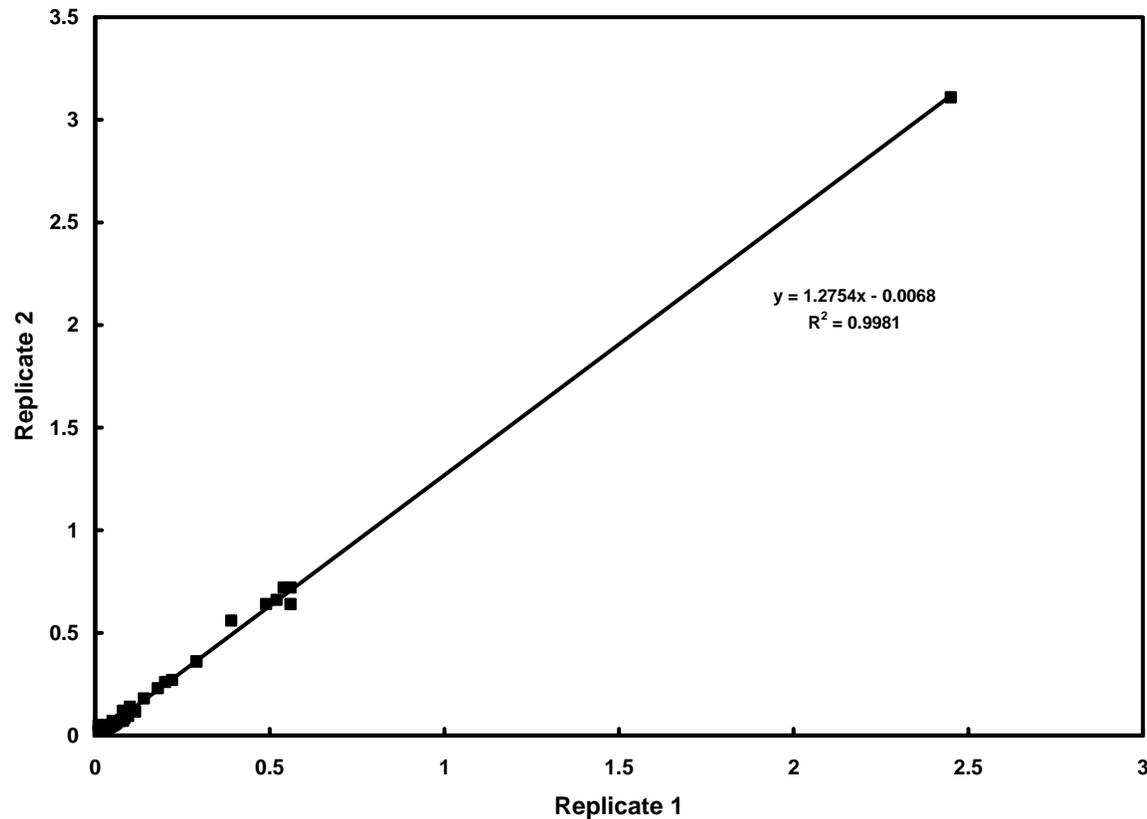
Precision Report

- New in 2003
- Allows reporting of duplicate (collocated) and replicate (second chemical analysis) samples into AQS
- Used to determine
 - Precision
 - Reproducibility of results
 - Confidence in measurements and sampling

Usefulness of Precision Report

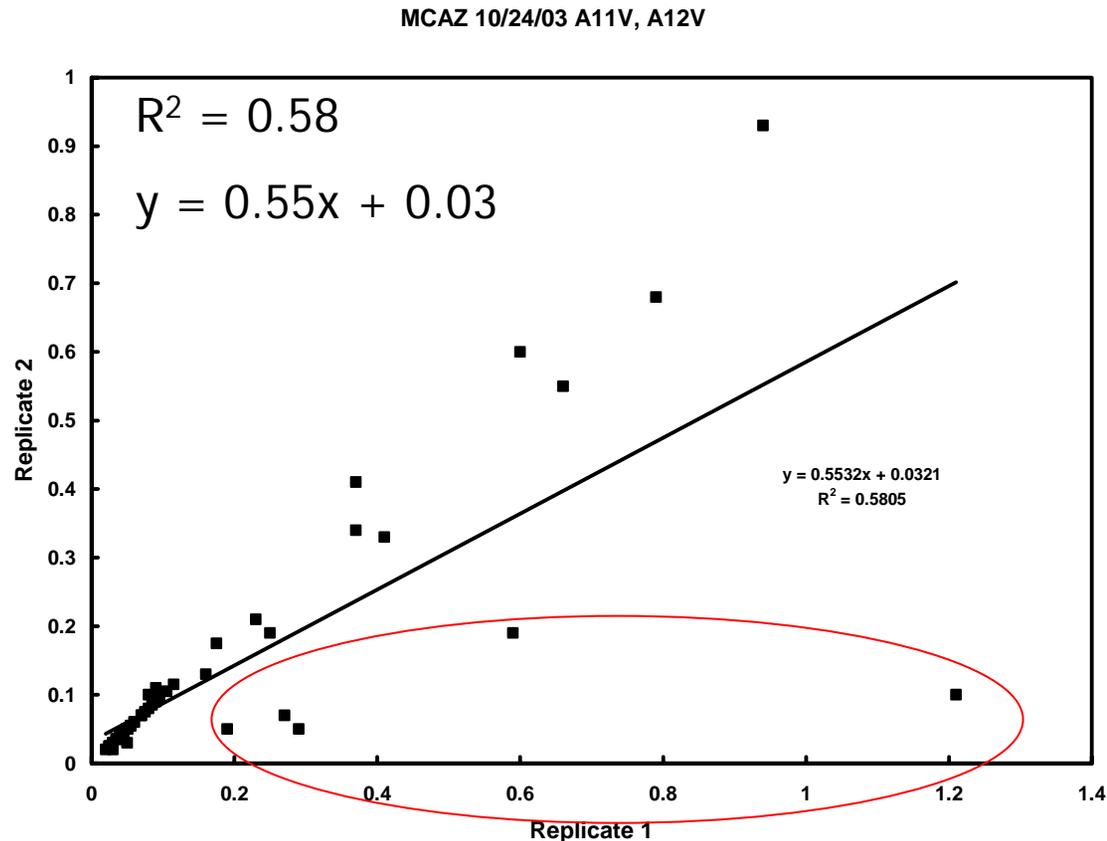
Compare Replicate Measurements (Good Example)

MCAZ 8/25/03 A11V, A12V



Usefulness of Precision Report

Compare Replicate Measurements (Bad Example)



Outliers
flagged as
suspect (poor
reproducibility)

Precision Report Format

- Text formatted cells were required to keep zeroes in front of AIRS Site Code.
- POC IDs indicate, from left to right, primary sample, duplicate, replicate, and duplicate-replicate samples.

Microsoft Excel - MCAZ_precision.txt

File Edit View Insert Format Tools Data Window Help

Type a question for help

Arial 10 B I U

Sort Ascending

	A	B	C	D	E	F	G	H	I
1			Sample			Precision Sample ID:	1	2	3
2	AIRS	Parameter	Duration	Unit	POC ID:	5	1	2	3
3	Code	Code	Code	Code	Method Code:	110	110	110	110
4	040134009	43813	7	8	7/26/03 0:00	0.030	0.030	0.030	0.030
5	040134009	43814	7	8	7/26/03 0:00	0.020	0.020	0.030	0.030
6	040134009	43820	7	8	7/26/03 0:00	0.046	0.046	0.046	0.046
7	040134009	43818	7	8	7/26/03 0:00	0.046	0.046	0.046	0.046
8	040134009	43826	7	8	7/26/03 0:00	0.055	0.055	0.055	0.055
9	040134009	43815	7	8	7/26/03 0:00	0.054	0.054	0.054	0.054
10	040134009	43829	7	8	7/26/03 0:00	0.036	0.036	0.036	0.036
11	040134009	45810	7	8	7/26/03 0:00	0.081	0.081	0.081	0.081
12	040134009	45208	7	8	7/26/03 0:00	0.040	0.040	0.110	0.110
13	040134009	43843	7	8	7/26/03 0:00	0.036	0.036	0.036	0.036
14	040134009	45207	7	8	7/26/03 0:00	0.010	0.010	0.050	0.040
15	040134009	43218	7	8	7/26/03 0:00	0.062	0.062	0.062	0.062
16	040134009	43702	7	8	7/26/03 0:00	0.310	0.320	0.200	0.213
17	040134009	43206	7	8	7/26/03 0:00	0.260	0.280	0.220	0.230
18	040134009	43704	7	8	7/26/03 0:00	0.185	0.185	0.190	0.200

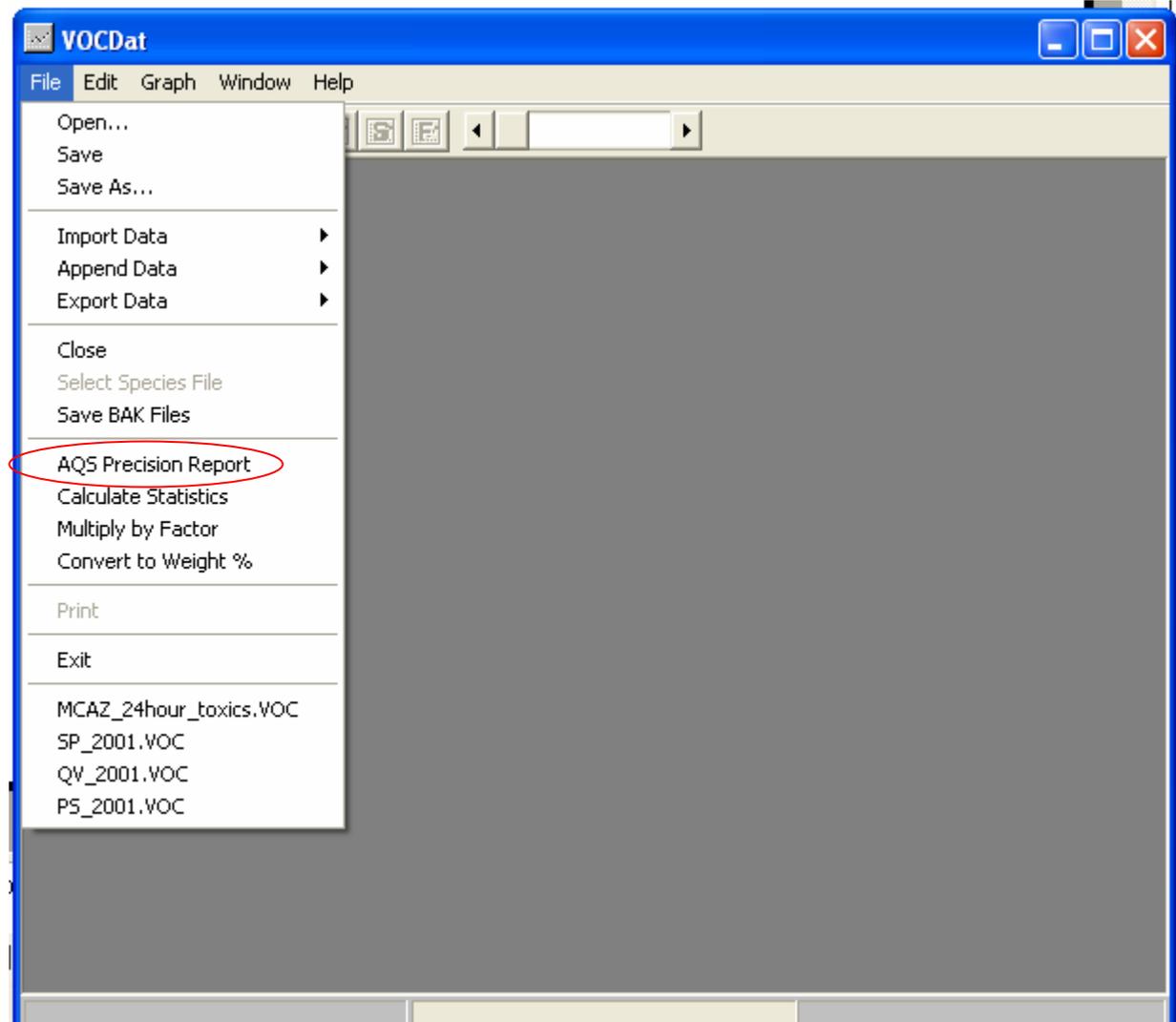
MCAZ_precision

Ready NUM

Example Setup File Available 

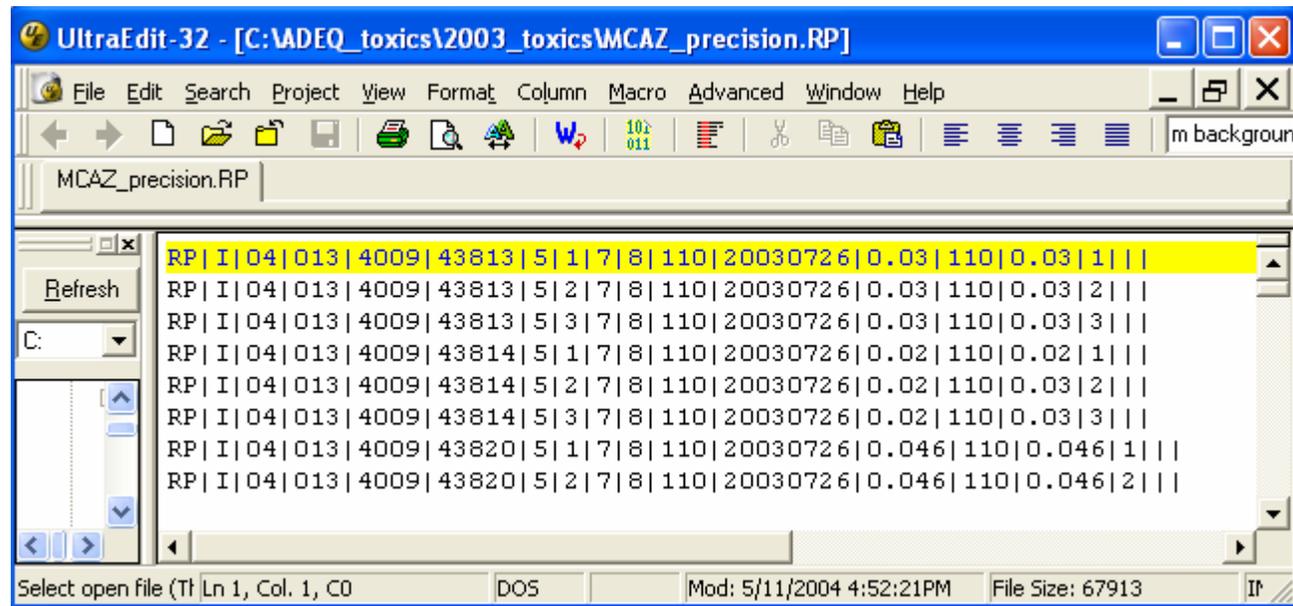
Creating Precision Report

- Import the text file (*.txt) into VOCDat by opening AQS Precision Report in the file menu.



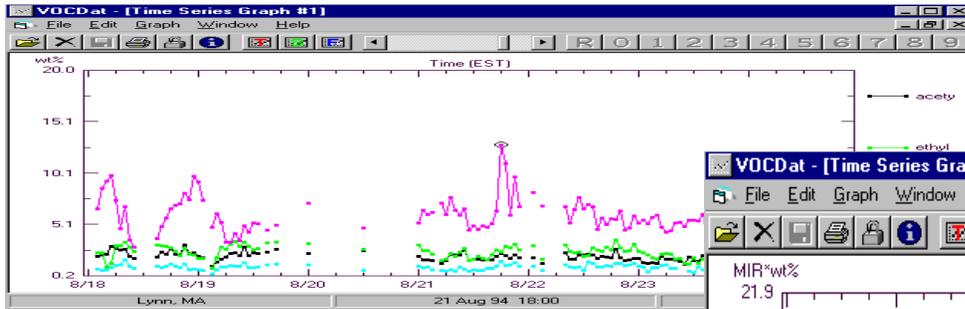
Resultant Precision Report

- Upon importing the file into VOCDat, the data is automatically exported as an *.RP file which is saved in the same folder as the imported text file.

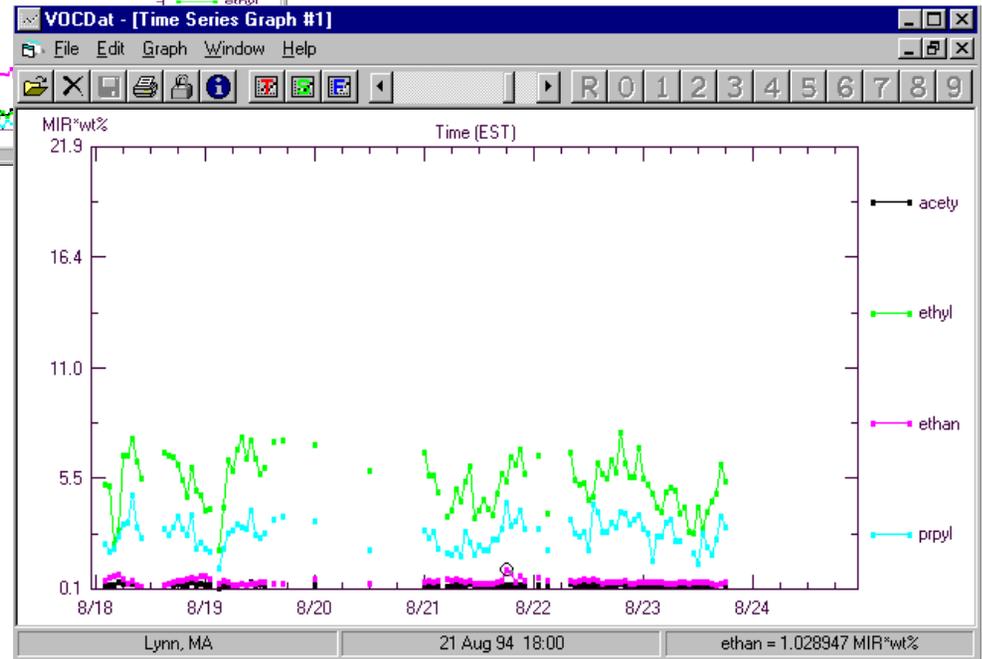


```
UltraEdit-32 - [C:\VADEQ_toxics\2003_toxics\MCAZ_precision.RP]
File Edit Search Project View Format Column Macro Advanced Window Help
MCAZ_precision.RP
Refresh
C:
RP|I|04|013|4009|43813|5|1|7|8|110|20030726|0.03|110|0.03|1|||
RP|I|04|013|4009|43813|5|2|7|8|110|20030726|0.03|110|0.03|2|||
RP|I|04|013|4009|43813|5|3|7|8|110|20030726|0.03|110|0.03|3|||
RP|I|04|013|4009|43814|5|1|7|8|110|20030726|0.02|110|0.02|1|||
RP|I|04|013|4009|43814|5|2|7|8|110|20030726|0.02|110|0.03|2|||
RP|I|04|013|4009|43814|5|3|7|8|110|20030726|0.02|110|0.03|3|||
RP|I|04|013|4009|43820|5|1|7|8|110|20030726|0.046|110|0.046|1|||
RP|I|04|013|4009|43820|5|2|7|8|110|20030726|0.046|110|0.046|2|||
Select open file (T) Ln 1, Col. 1, CO DOS Mod: 5/11/2004 4:52:21PM File Size: 67913 IP
```

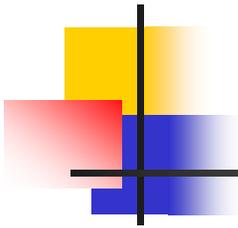
Using Other Forms of the Data



Weight Percent

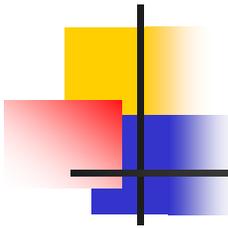


Reactivity-weighted or
Risk-weighted



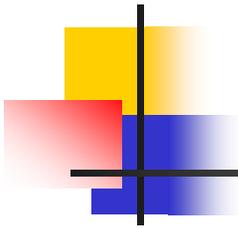
Toxicity/Risk Factors

- EPA's Integrated Risk Information System – IRIS (see <http://www.epa.gov/iris/index.html>).
- EPA Health Effects Notebook for Hazardous Air Pollutants (see <http://www.epa.gov/ttn/atw/hapindex.html>).
- EPA National Center for Environmental Assessment (NCEA) (see <http://cfpub.epa.gov/ncea/cfm/nceahome.cfm>).
- California EPA (see <http://www.oehha.ca.gov/>).
- Modeling Cumulative Outdoor Concentrations of Hazardous Air Pollutants by Systems Applications International, Inc. - Revised Final Report (see <http://www.epa.gov/cumulativeexposure/resource/report.htm>).
- California Air Resources Board Toxic Air Contaminant Identification List Summaries (see <http://www.arb.ca.gov/toxics/tac/tac.htm>).
- Application of Health Information to Hazardous Air Pollutants Modeled in EPA's Cumulative Exposure Project by Jane C. Caldwell, Tracey J. Woodruff, Rachel Morello-Frosch, and Daniel A. Axelrad (1998) (see <http://www.epa.gov/cumulativeexposure/CEPpapers/paperCWMA.pdf>).



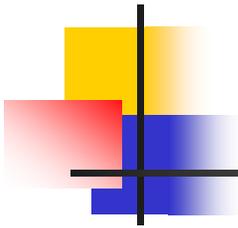
New Additions – Unit Conversion

- Select units when bringing into VOCDat
- Convert among
 - ppbv (gaseous and semi-volatile HAPs)
 - ppbC (PAMS, auto-GC, VOC)
 - $\mu\text{g}/\text{m}^3$ (semi-volatile, particulate HAPs)
- $\mu\text{g}/\text{m}^3$ is focus for risk assessment
- Must assume pressure, temperature when converting, which can cause up to 20% variability/uncertainty



New Additions – Import Formats

- Currently working to be able to import data in additional file formats from labs:
 - ERG (HAPs)
 - RTI (PM_{2.5})
- Some consistency will be needed in format
- Communicate with labs, EPA and STI – let us know what formats you want and could more easily use, with examples



Obtaining VOCDat

Available free at

<ftp://ftp.sonomatech.com/public/vocdat/>

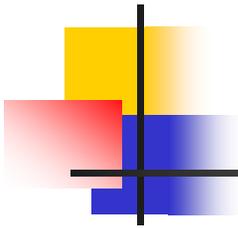
To register and get technical support, call

Hilary Hafner or Steve Brown

at (707) 665-9900

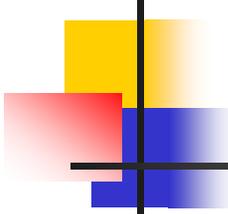
or e-mail

VOCDat@sonomatech.com



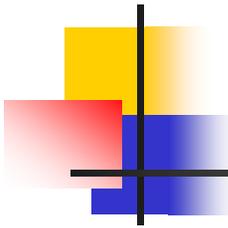
Problems? Issues?

- User's guide has lots of good information (updates coming soon)
- Data validation and VOCDat workshop material available online:
 - http://www.sonomatechdata.com/sti_workbooks/
 - <http://www.ladco.org/toxics.html>
- Still can't get it to work? E-mail VOCDat@sonomatech.com
 - Specific problem file, species file, note version, screenshots of specific error



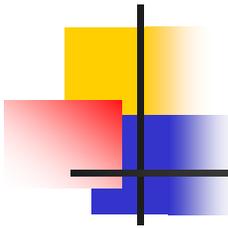
Summary

- Graphical techniques are useful to quickly and efficiently validate (and begin analysis of) aerometric data.
- VOCDat is extremely useful in processing and validating air toxics data
- New additions:
 - Precision report
 - New file formats
 - Unit conversions



Other Additions and Ideas?

- As always, a major VOCDat overhaul would be great...
- Other import file formats?
- Additional QC checks?
- Can we input comments into AQS?
- Is there a standard QC code list for comments?
- Web site for FAQs



Glossary

AIRS – Aerometric Information Retrieval System

AQS – Air Quality System

auto-GC – auto-Gas Chromatography

BC – black carbon

CFCs – chlorofluorocarbons

CSV – comma separated values

DPM – diesel particulate matter

EPA – U.S. Environmental Protection Agency

ERG – Eastern Research Group

HAPs – Hazardous Air Pollutants

NATTS – National Air Toxics Trends Sites

PAMS – Photochemical Assessment Monitoring Stations

PM – Particulate Matter

POC – parameter occurrence code

QC – Quality Control

RTI – Research Triangle Institute

VOC – Volatile Organic Compounds