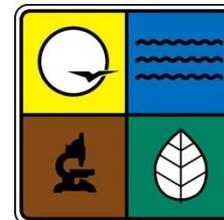


Operating Experience with the Sunset Carbon Semi-Continuous OC/EC Instrument in St. Louis Missouri

Will Wetherell and Jerry Downs



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Missouri Department of
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 **40
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Introduction

- The Sunset Carbon Evaluation Project by EPA's Office of Air Quality Planning and Standards(OAQPS) Ambient Air Monitoring Group (AAMG) is working with State and local monitoring agencies to collect field data at seven (7) sites across the United States using the Sunset Semi-Continuous Organic and Elemental Carbon (OC/EC) instrument.
- This project is an instrument evaluation and feasibility study of the Sunset (OC/EC) instrument as well as a data comparison with the URG 3000N and Magee Scientific Aethalometer where present.

Project Plan

- Evaluating instrument performance in various geographic/climatic/source regimes across the country, during different seasons
- Gaining proficiency in the proper operation and maintenance of the instrument
- Evaluating comparability of the Sunset thermal OC/EC with the URG 3000N thermal OC/EC
- Evaluating comparability of the Sunset optical EC with the Aethalometer optical black carbon (BC), where present

Project Plan

- **Evaluating ease of use, level of effort to maintain, and operation in a routine monitoring network setting**
- **Refining the QC procedures based on the findings and developing training materials**
- **Determining if implementation across a larger number of CSN sites is appropriate**





Semi-continuous Real-time Carbon Analysis (c) Sunset Laboratory Inc. - Software Version RTOCEC62353

File Run Options Window Help

SAMPLE ID #:

PAR FILE : ...

Output Raw Data file : ...
 NOTE: Must End with ".txt" or "\"

Sample collection time (minutes)



Use Sample File Times

Cycle Plot Min. EC

Flow Table Plot OCEC



RT1 GAS FLOWS AND A

<input type="text" value="9.9"/>	He1
<input type="text" value="4.8"/>	He
<input type="text" value="10.0"/>	He/
<input type="text" value="5.4"/>	Cal

<input type="text" value="0.00"/>	San

RT1 Status

Safe to put in a new sample

Status :

Start Collection : Valve Value Table

Time so far: Last Cycle Values

Front Oven PSIG: TC ug/m3 Laser Correction

Back Oven Laser: Time



Semi-continuous Real-time Carbon Analysis (c) Sunset Laboratory Inc. - Software Version RTDCEC62353

File Run Options Window Help

Start Analysis []

Cancel This Run [inst_software\par\fast-tc.par]

Dry wet Filter (<12 ul) [inst_software\rawdata\august2014] End with ".txt" or "\"

Clean Oven []

Sample collection time (minutes) []

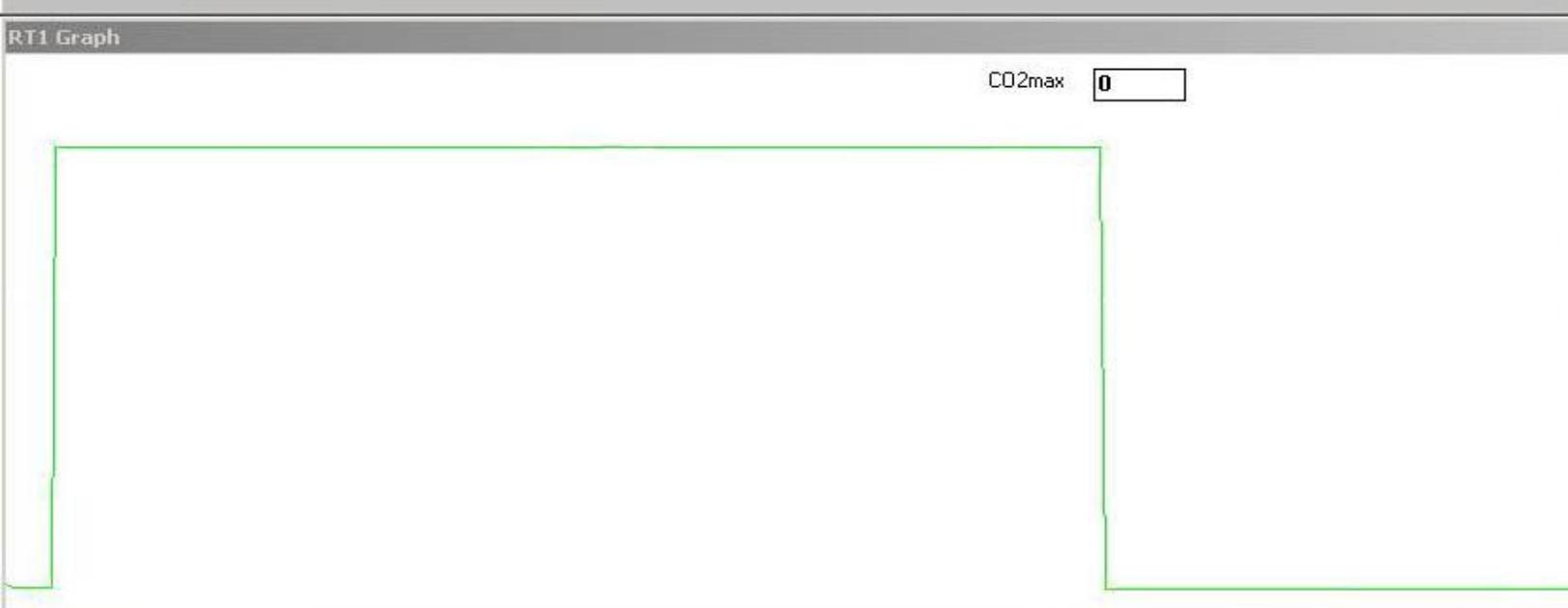
Use Sample File Times

Cycle Plot Min. EC

Flow Table Plot DCEC

Start Analysis []

Cancel This Run []

RT1 GAS FLOWS AND A

10.0 He

4.9 He

9.9 He

5.7 Cal

0.01 Sa

RT1 Status

Safe to put in a new sample

Status : **Checking**

Start Collection : 14:00

Time so far: 0:00 s

Front Oven 31.2 PSIG: 0.19 psig

TC ug/m3 [] Laser Correction []

Valve Value Table

Last Cycle Values



Sunset Laboratory Inc. - Software Version RTOCEC62353

Sunset Laboratory Inc. - OCEC Calc Prog

File Help UpdatesLog

OC/EC Analysis Program RT-3150 07/30/2014 11:00:00

Split point, sec.:
 Automatic Manual set
 237 <-->
 Recalc (with these options)

NDIR Graph Scale Factor: 10
 Laser Graph Scale Factor: 10

Close Program
 Print this sample
 Print All to Printer
 Calculate all Samples
 Separate Inst Blanks to BlanksRes.txt file

Sample ID: RT-3150
 Date/Time: 07/30/2014 11:00:00

Organic C = NA
 Carbonate C = 0.00 +- ugC
 Elemental C = NA
 Total C = 1.17 +-0.36 ugC

BaseVolatile area = 2058.0
 Pyrolyzed area = 0.0
 Base EC area = 0.0
 Calibration area = 39790.0
 OptEC = 0.113 ugC

Manual peak: start = 0 end = 0
 Integrate Manually Integrated Area =

Temperature Laser Transmittance Absorbance 0-2

Re-Display Sample

RT-3150
 RT-3150
 RT-3150
 RT-3150
 RT-3150
 RT-3150
 RT-3150
 RT-3150
 RT-3150

(Double Click Sample to Redisplay)

He peak areas:

1 - 2045.0	0.994
2 - -9999.0	-4.859
3 - -9999.0	-4.859
4 - 2047.0	0.995

Pyrolyzed C area = .0
 True EC area = .0
 Total area = 2058.0
 Initial Absorbance = 0.002
 Maximum Absorbance (290 s)= 0.265
 Split time Used = 237 seconds
 Sample Volume = 388.66
 AB.COEF. (PYR EC) = 2000000000
 AB.COEF. (ORIG EC) = 2000000000

OC/EC Analysis Program (c) Sunset Laboratory, Inc.
 DL laser offset = 10 Pressure EC/TC ratio 8523.97
 Status NDIR Data!!!

Sta Collection

Time so far: 0:00 s

Time: 5:15

Last Cycle Values

TC ug/m3 Laser Correction

stalogger.ht

shortcut to F:\OCEC_...

SunsetDocs

RT CALC

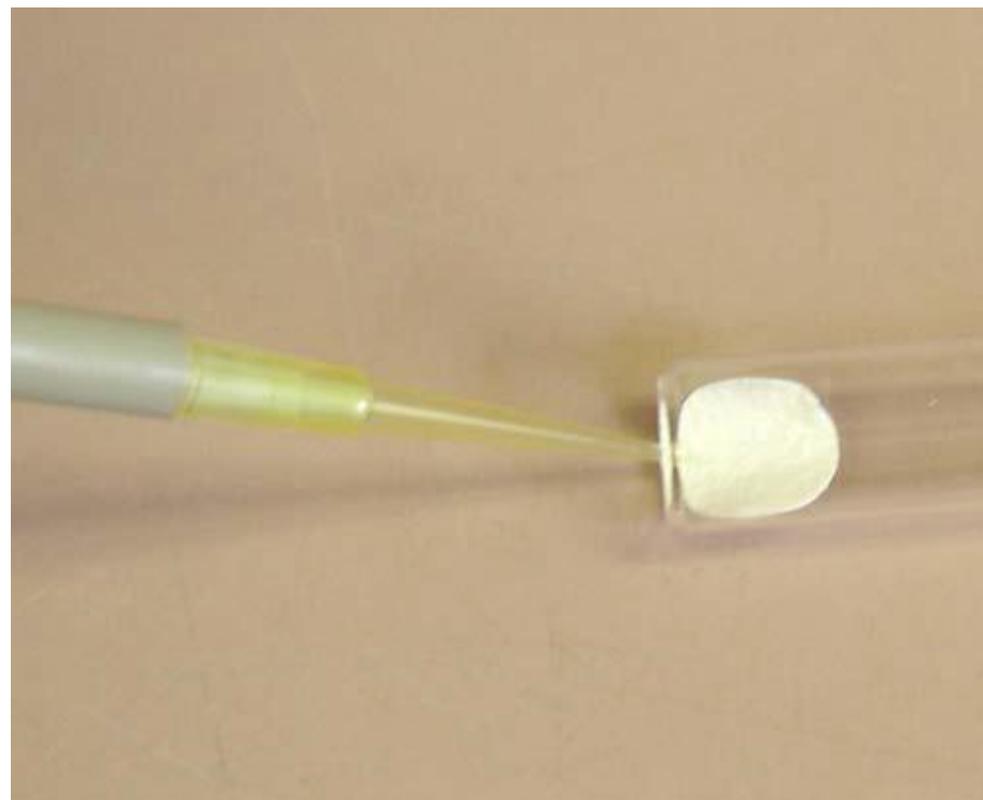
shortcut to R:\Calc630...

Weekly QC/Routine Maintenance

- Primary (>250 PSI) & secondary (~12 PSI single analyzer)
- pressure for support gases
- Blank Values (< ± 0.3 μg TC)
- Analyzer Gas Flows (relatively stable)
- Laser correction value (>0.90)
- Back Oven Temperatures
 - 870C during analysis
 - 500C during sampling
- Clean inlet dropout tee
- Autozero flows
- Download data as backup
 - Raw data file
 - Results file
 - Minute EC file
 - Blank results file
- Change filter

Bi-Weekly Single Point External Standard

- Two filters installed like normal
- and 3rd “boat” filter installed at end of quartz insert
- • All 3 filters cleaned in oven
- • 10 μL stock sucrose solution
- (~42.1 μg TC) injected onto
- “boat” filter
- • Analyze and confirm instrument
- detects within $\pm 5\%$ of the
- expected sucrose concentration



Monthly QC/Routine Maintenance

- Replace denuder filter papers
- Flow Check (8 ± 1.2 LPM)
- Clean cyclone inlet
- Leak Check



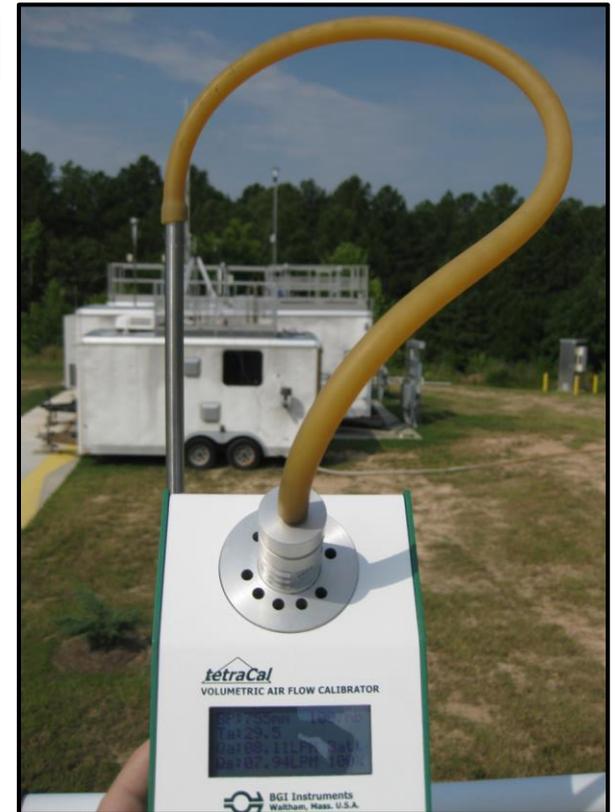
Quarterly QC/Routine Maintenance

- 48 hour dynamic blank test



Semi-Annual QC/Routine Maintenance

- Multi-point external standard
- Clean inlet tubing
- Flow sensor calibration

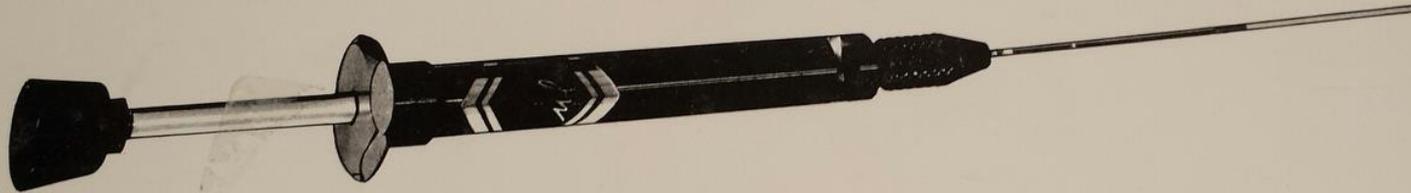


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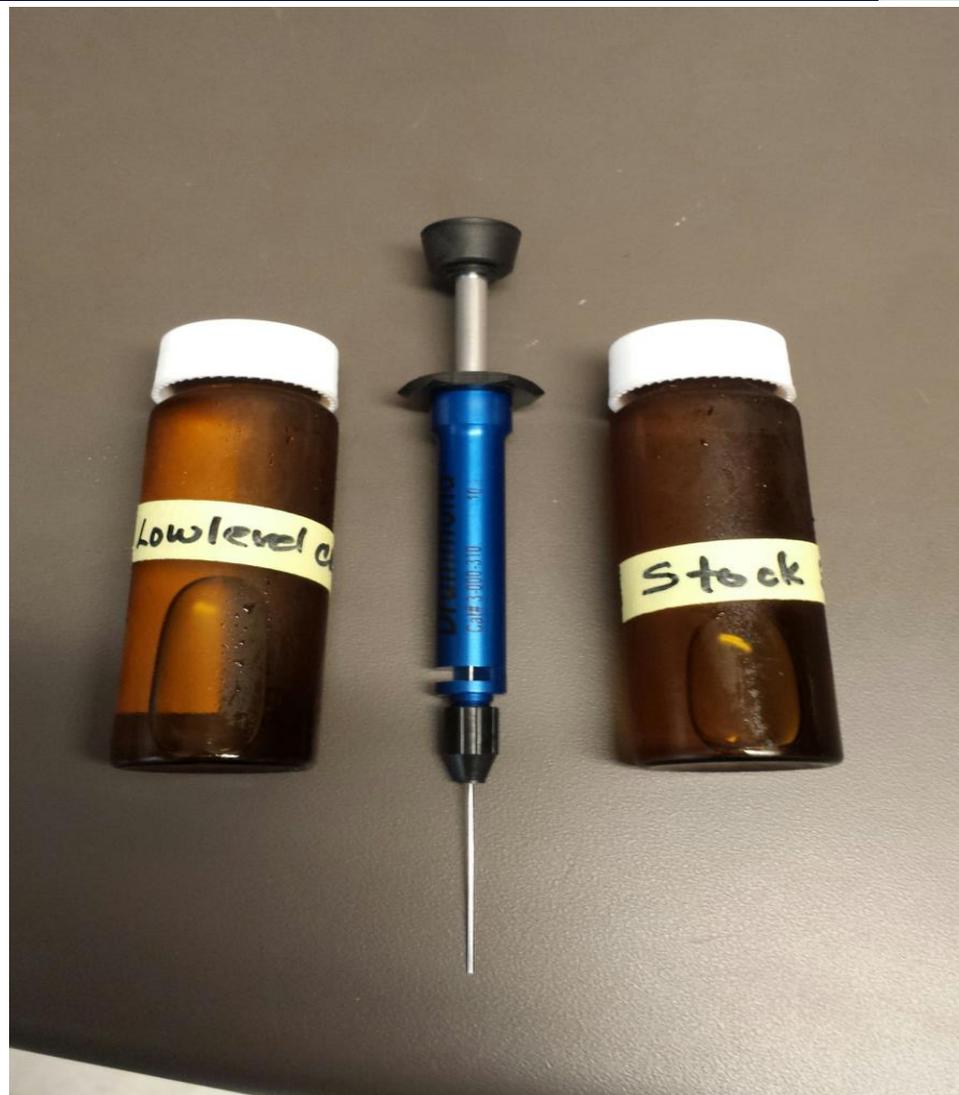


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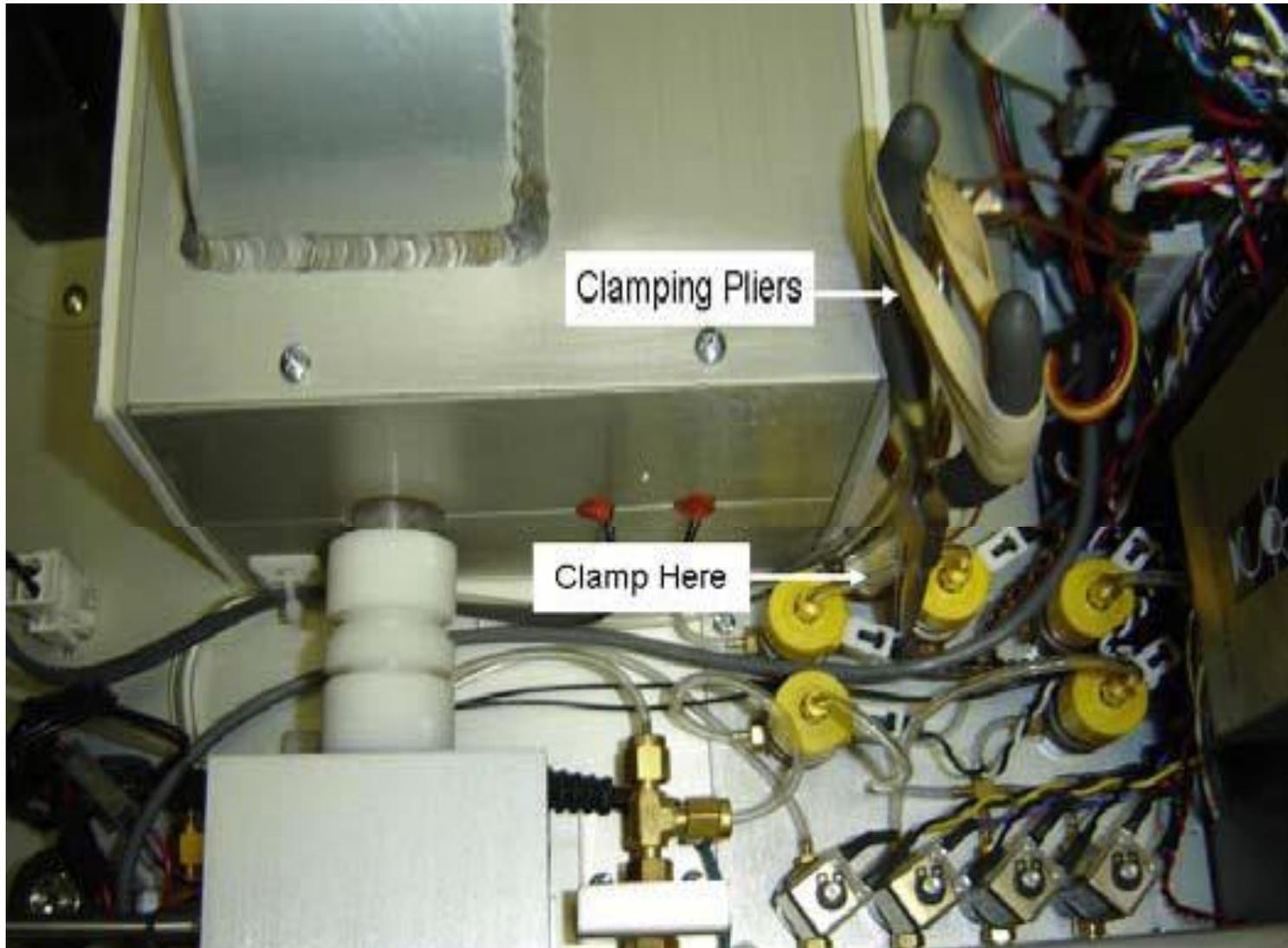
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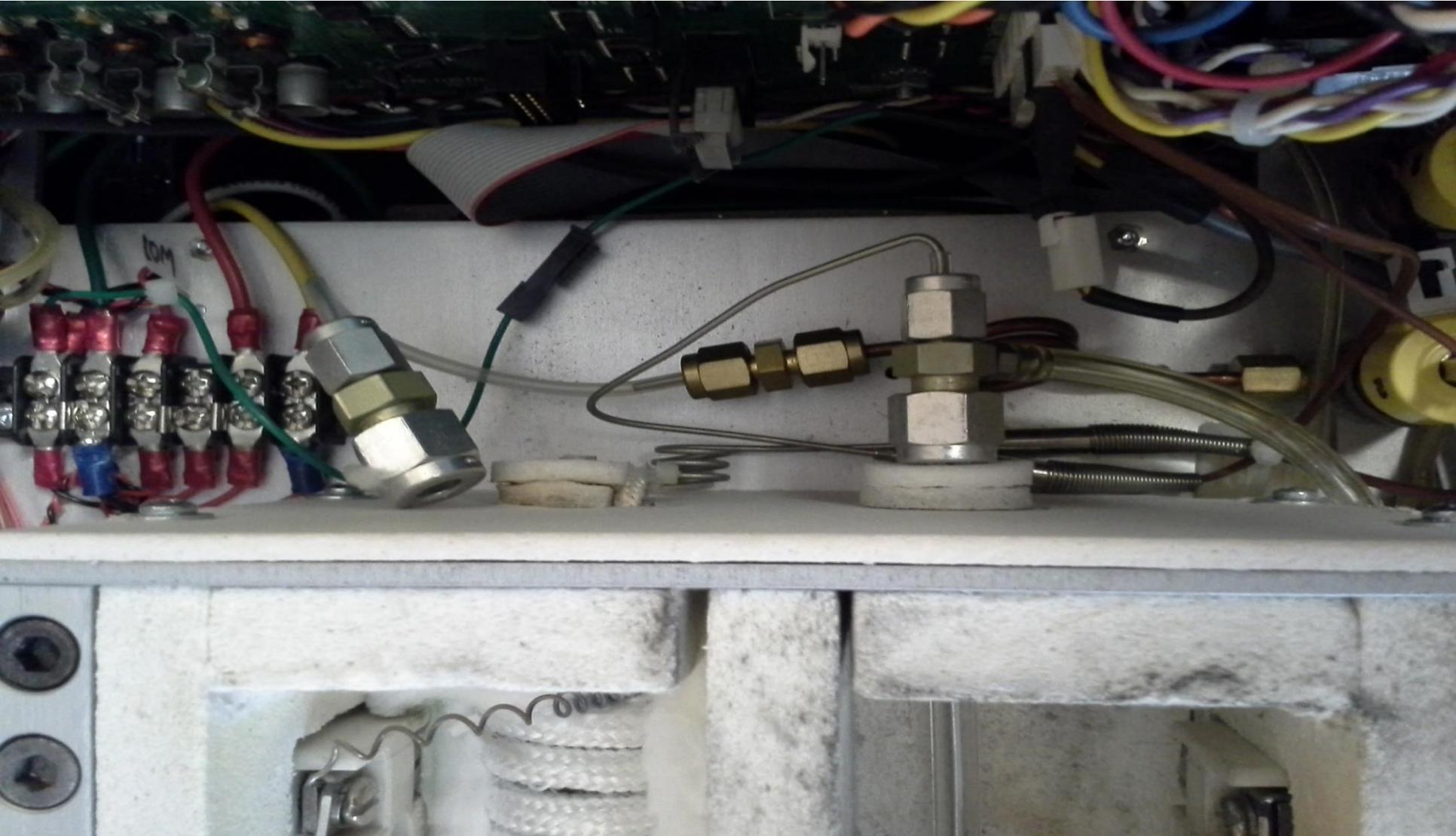


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Our Experiences

- Instrument is more labor intensive compared to related air monitoring instruments
- Instrument software did not have a good user interface. It was easy to pick the wrong file. Especially picking two files per operation
- Instrument interface with ESC dataloggers. It took a little work to get them talking to each other
- Instrument flow calibration is not a straight forward process.
- Instrument ambient temperature and pressure calibrations are also not a straight forward process

Our Experiences

- Instrument ambient temperature probe is not stable compared to other air monitoring instruments
- Filter flipping sideways or not seating properly - verify filters are installed properly and fittings tightened down after filter change and having correct number of filters installed
- Laser correction values may run lower than limit (>90) at some sites
- It is very easy to break the glass oven
- Heater coils go out quicker when not installed correctly
- Can go two weeks before changing out filters, plus to doing bi-weekly checks

Conclusions

- Maintenance and operation of the Sunset OC/EC is not comparable to that of other air monitoring instruments.
- With some software user interface updates the instrument would be more comparable to other air monitors
- With combined QC and Routine checks would make operating less time consuming
- Sunset OC/EC does have comparable data to related air monitoring instruments
- Sunset OC/EC does give us more real-time data than filter based instruments

Acknowledgements

- Missouri Department of Natural Resources
 - Jerry Downs, Jim Brunnert, Dustin Kuebler, David Malorin, Will Wetherell, Steve Hall
- U.S. EPA / Office of Air Quality Planning and Standards
 - Beth Landis, Joann Rice
- Sunset Laboratory Inc.
 - Josh Dixon, David Smith

Division of Environmental Quality Director: Leanne Tippett Mosby

Date: August 13, 2014

Nothing in this document may be used to implement any enforcement action or levy any penalty unless promulgated by rule under chapter 536 or authorized by statute.

Online Current Data

- <http://www.dnr.mo.gov/env/esp/aqm/allguide.htm>
(Click on “Current Air Pollution Data Report” at mid-page, scroll down to Blair Street Data)

References

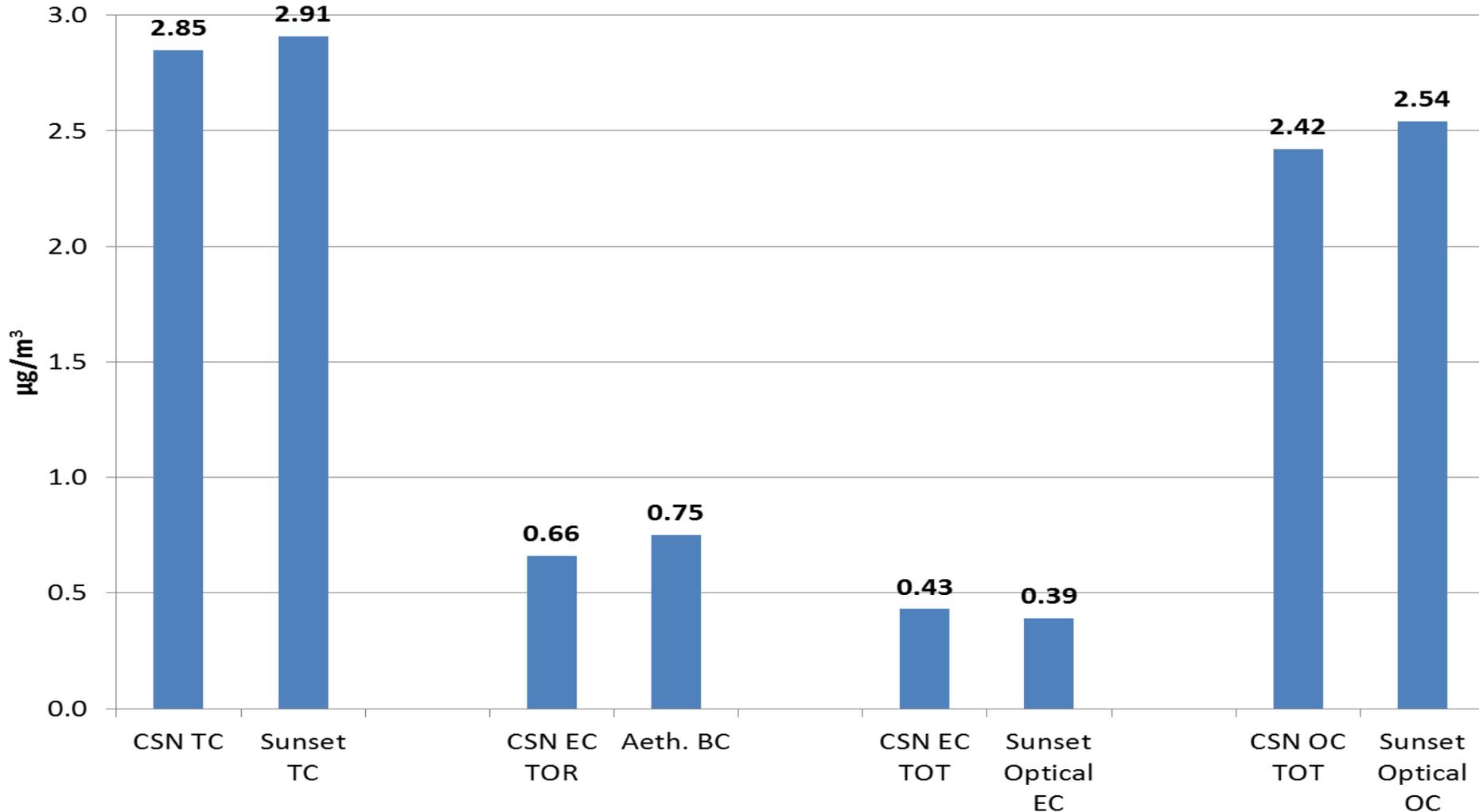
- The following are provided at on the Sunset OC/EC Evaluation Project Site on AMTIC
(<http://www.epa.gov/ttnamti1/spesunset.html>)
 - Sunset Manual
 - Draft SOP
 - QAPP for OAQPS Sunset Evaluation Project

Additional Information

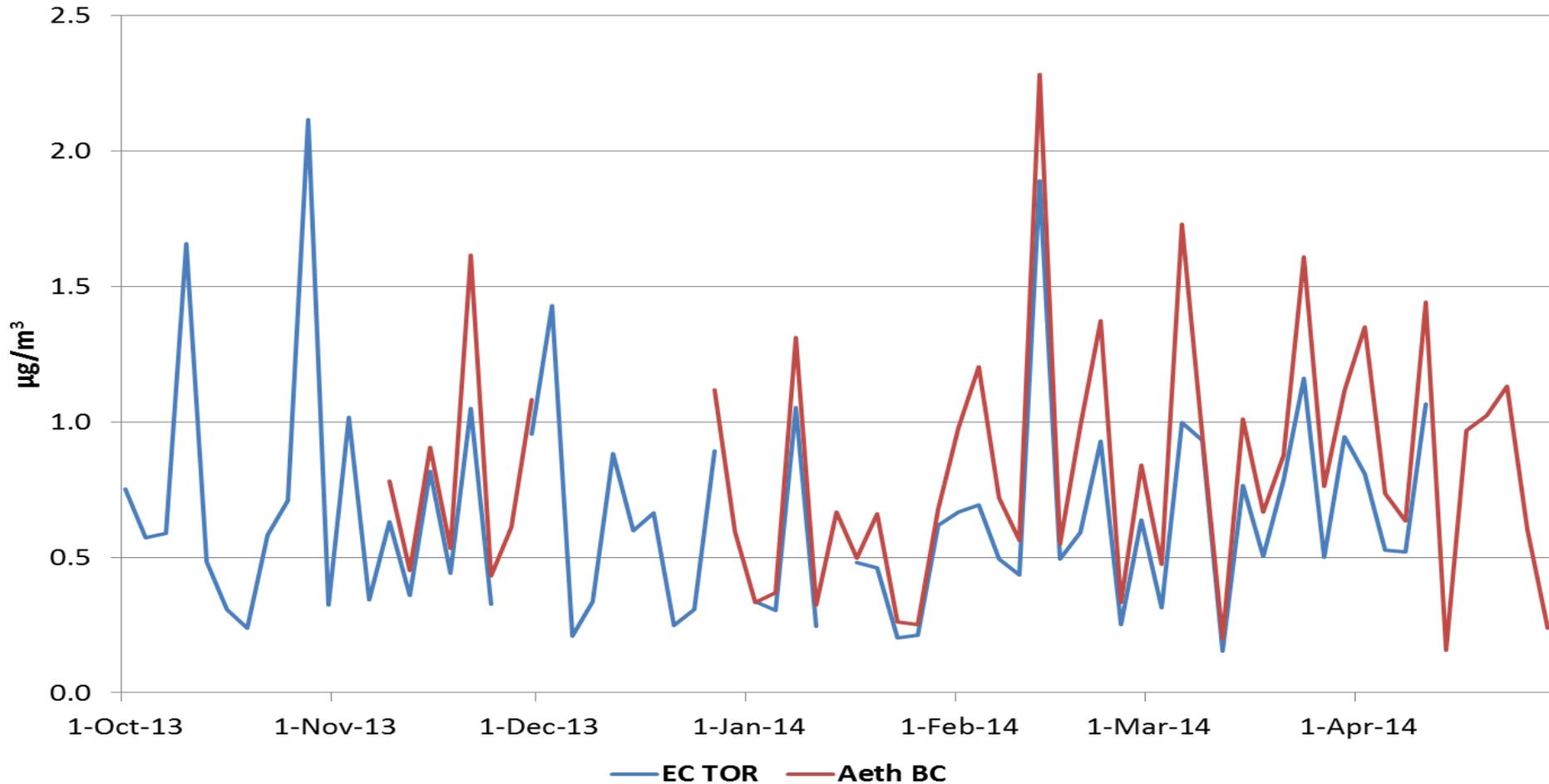
*Comparison of Sunset with URG 3000N and
Aethalometer at Blair Street NCore site in
St. Louis, MO*



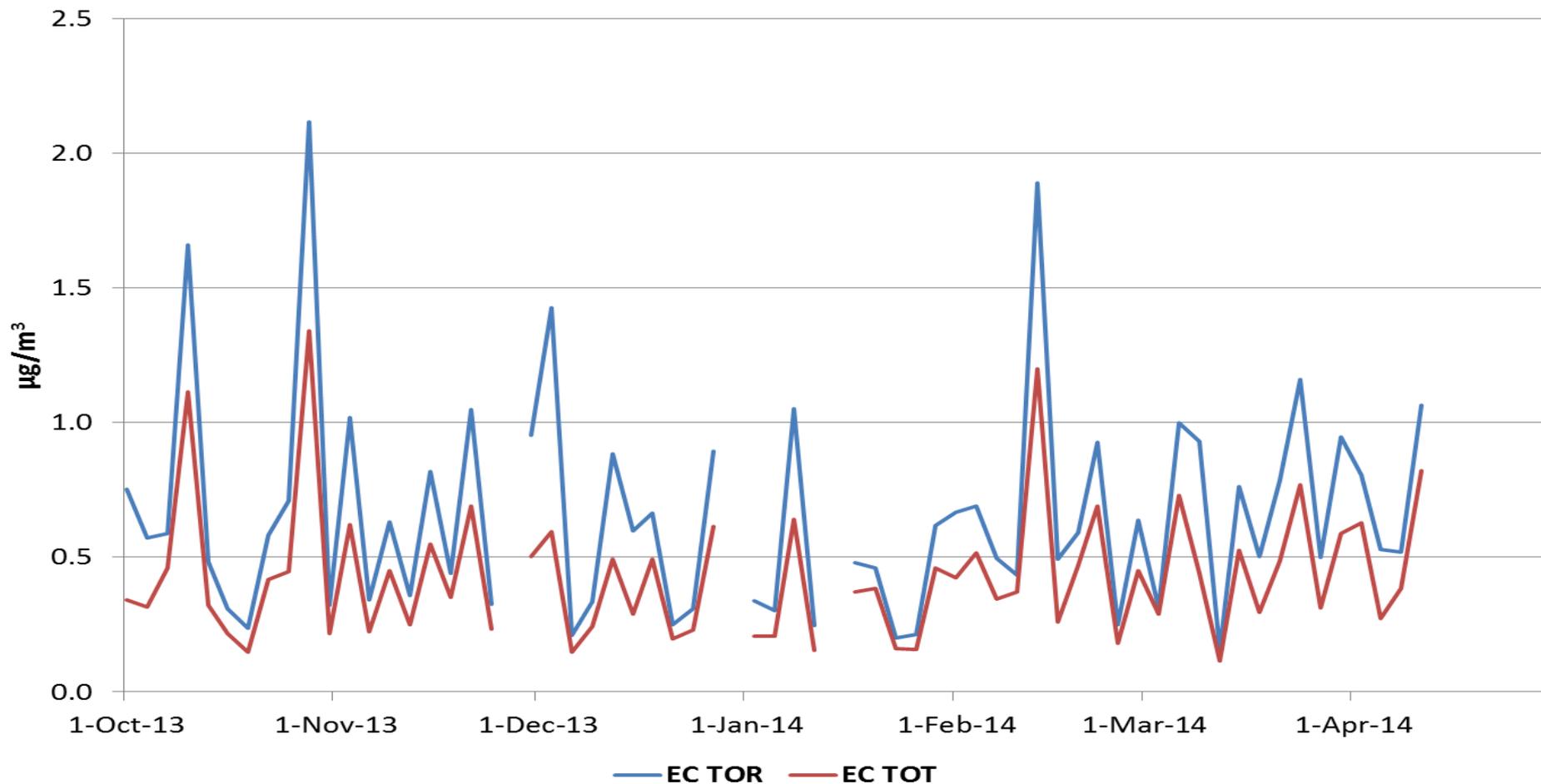
Blair St. Carbon Measurement Averages, October 2013-April 2014



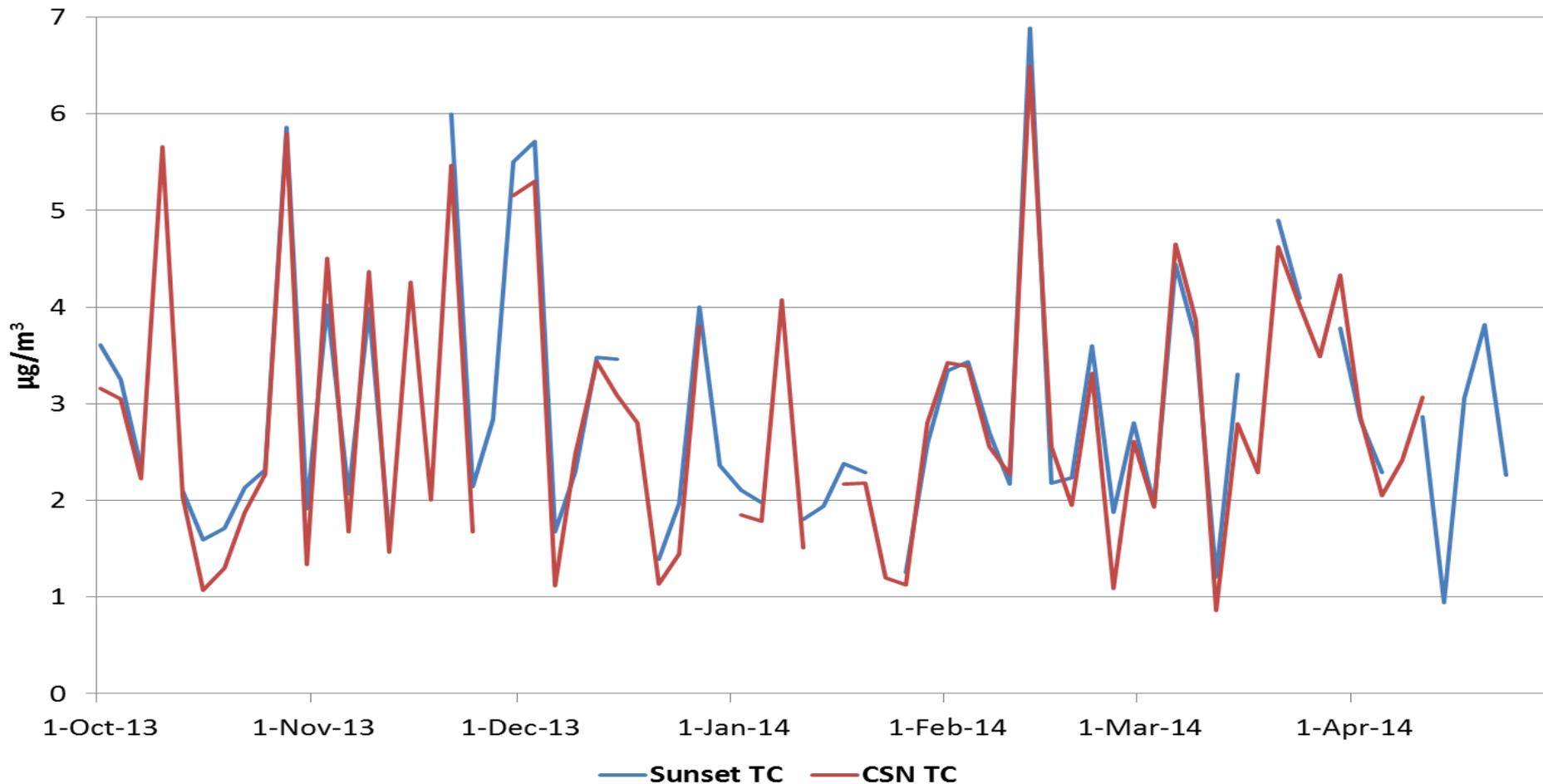
Blair St. CSN EC TOR and Aethalometer Black Carbon (every third day)



Blair St. CSN EC TOR and EC TOT (every third day)

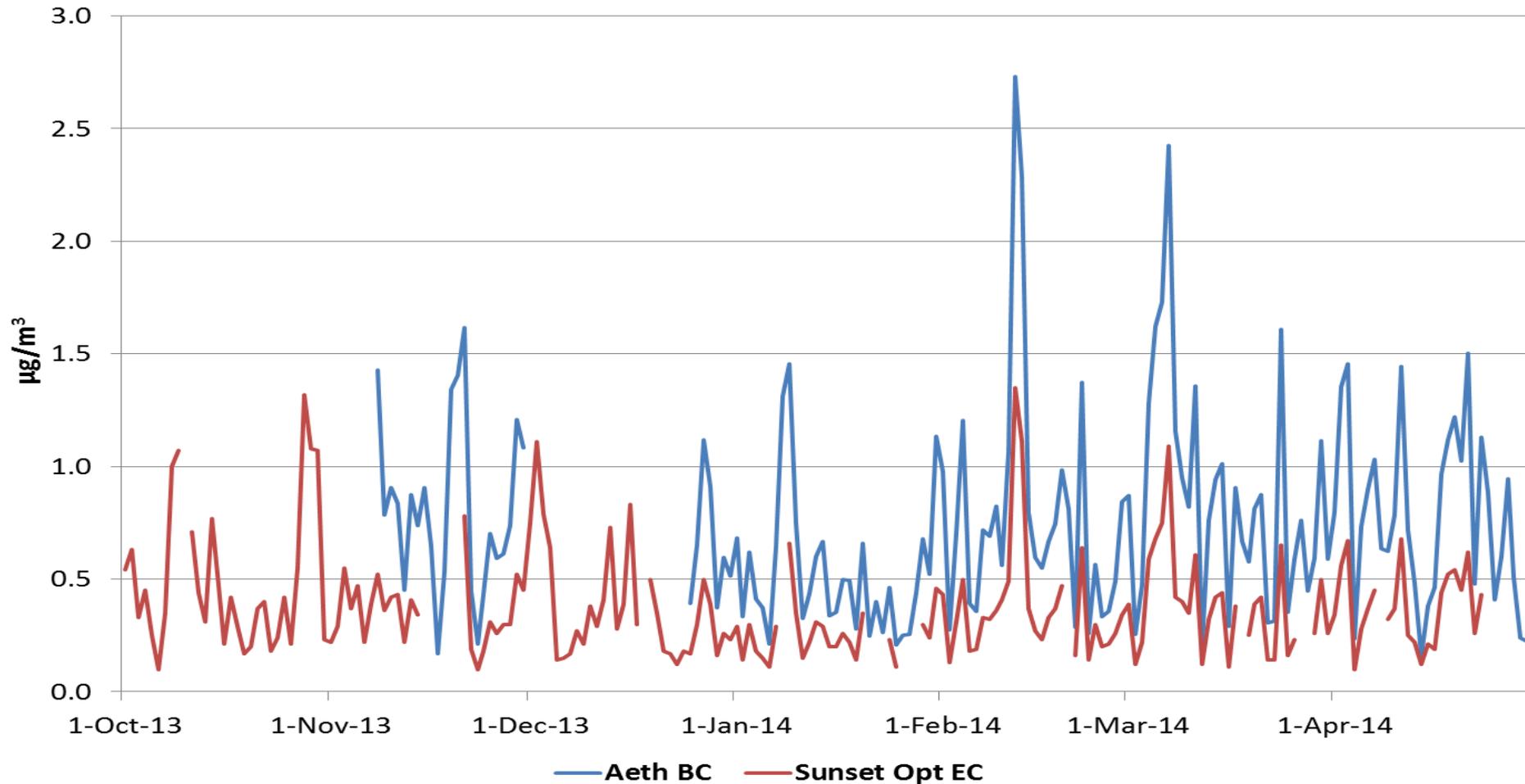


Blair St. Sunset Total Carbon and CSN Total Carbon (every third day)





Blair St. Aethalometer Black Carbon and Sunset Optical EC (every day, 24 hour averages)



Blair St. Sunset Optical EC, CSN EC TOR, and CSN EC TOT (every third day)

