

TAPI 633 (Magee AE33) Aethalometer: New Features, Performance, and Best Operating Practices

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NAMC, Atlanta, GA August 13, 2014

INTRODUCTION

- TAPI 633 Aethalometer now widely used in US networks
- Method is robust, mature
- VERY different from “Legacy” Aeths (AE21/22/31/42)
 - real-time correction for spot-loading artifact
 - requires different operating protocols, QC, data review/validation
- This Presentation:
 - QC Suggestions
 - Vendor Software Tools
 - “Things to be aware of”

- Quick Review: TAPI 633

21st Century hardware/software platform

2 Aethalometers in 1 box

Different flow rates on the 2 sample spots:

==> different rates of aerosol loading

generates “K” parameter used for loading compensation

T60 Teflon/glass fiber filter media (replaces quartz)

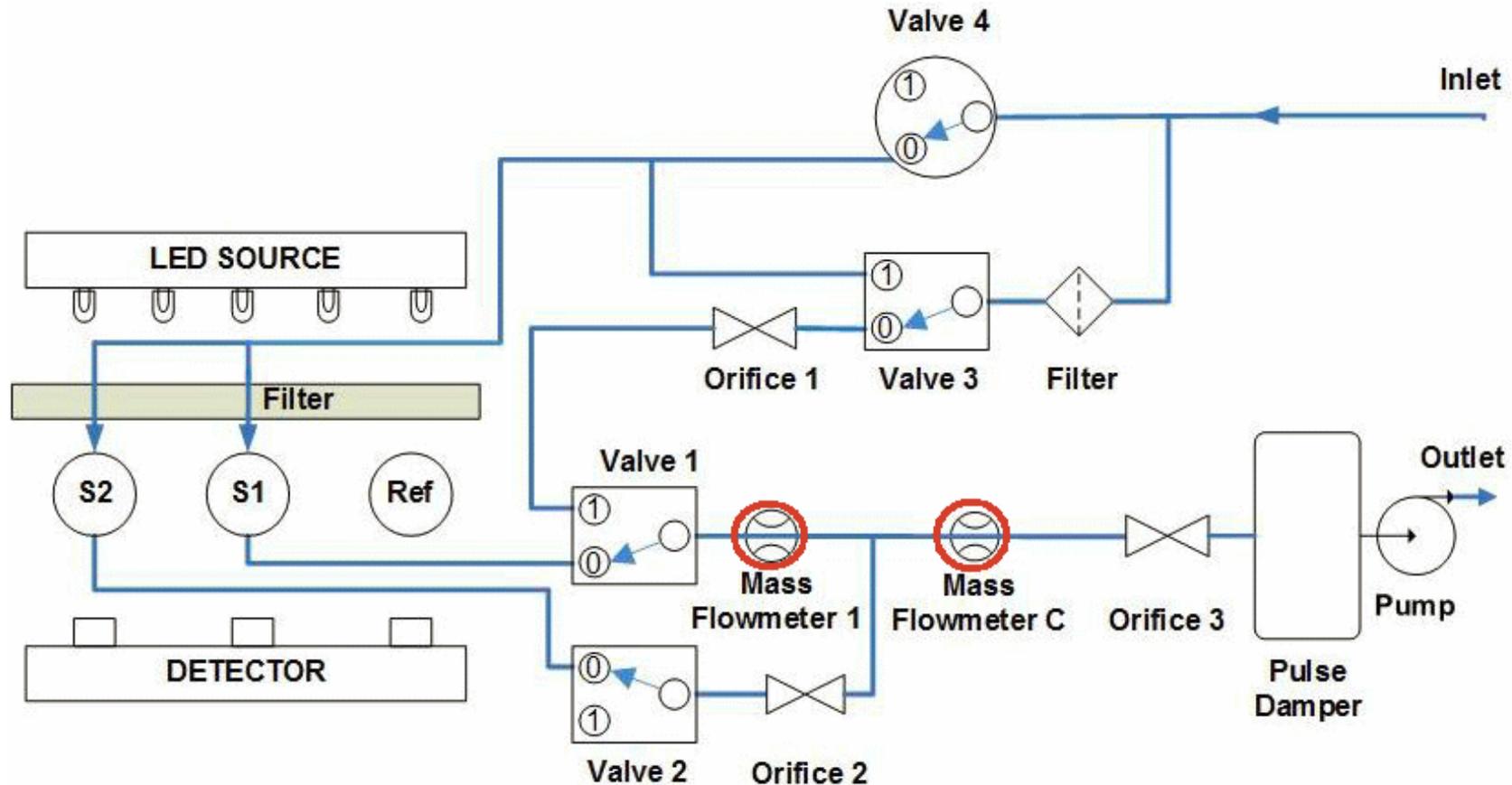
Reduces interference from rapid RH changes

- See also 2012 Denver NAMC 633 Aethalometer Presentation

<http://www.epa.gov/ttn/amtic/files/2012conference/3A03Allen.pdf>

Flow Diagram Now Available (in next TAPI manual rev)

Valves shown in operating mode



Note location of 2 flowmeters (in series for flow cal) - red circles

QC Suggestions

Flow and Leak Checks

Very different procedure from Legacy Aeth

Do NOT use “block the inlet” for leak check!

Use flowmeter without pressure pulses (BGI tetraCal, TSI-4100)

Flow Cal does not report “as found” or post-cal flow errors

Do “as found” FV before any Flow Cal

Must set FV or FCal T to 25 C each time if using tetraCal@STP

Default is 21 C (for TSI-4100 mfm)

FV “Trigger” for FCal:

Recommend FCal if any flow >3% in FV summary (my limit)

The “George” Flow Procedure:

Combine flow verification / flow cal / flow verification / leak check

“George” FV/Leak Check Procedure:

1. Perform a "flow verification" as described in the manual.
Note “Fin” and “Fc” for the highest flow point on the 633 screen at the end of the flow verification procedure. [or get it from the FV log file]
2. Start the instrument in normal “Run” mode. Wait ~ 15 minutes.
3. Measure the inlet flow with the same flowmeter.
4. Correct the external flow measurement value as shown on the next page (this adjusts the external flow meter reading to be the same as the internal instrument flowmeter).
5. The leak test value is the % difference between the inlet flow [as measured during operation using the corrected flowmeter reading] and the reported total flow as shown by the instrument in the "Operation", "Advanced" screen as "Flow Σ " [above "Flow 1" on the instrument display].
6. This value should be no more than 7% -- typically ~ 3 to 4%.

Example of Flow Verification result.

These results are in the FV log files.

Fin is external flow measurement

F1 is flow for sensor 1 (higher loading)

Fc is total (“inlet”) flow, or "Flow Σ "

Flow reporting standard: EPA 101325 Pa 25 °C

<u>Fin</u>	<u>F1</u>	<u>(%)</u>	<u>Fc</u>	<u>(%)</u>
736	746	(101)	742	(101)
2470	2394	(97)	2387	(97)
4120	4190	(102)	4190	(102)

Correction to external flowmeter for leak check use:

$$4190/4120 = 1.017$$

adjusts external flowmeter to match internal Fc

QC Suggestions - Collocation

Co-location of Aeths:

Very important if mix of legacy and 633 models

Preserve spatial patterns / temporal trends

Not important if no other BC or EC measurements in airshed
e.g., a single Aeth, no CSN etc

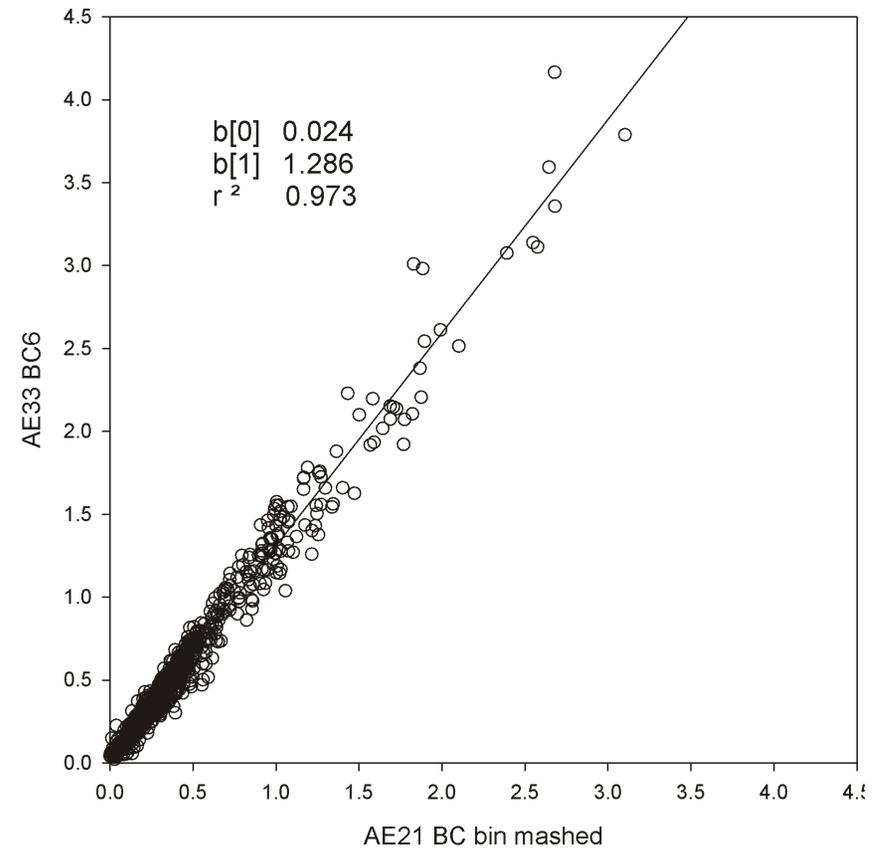
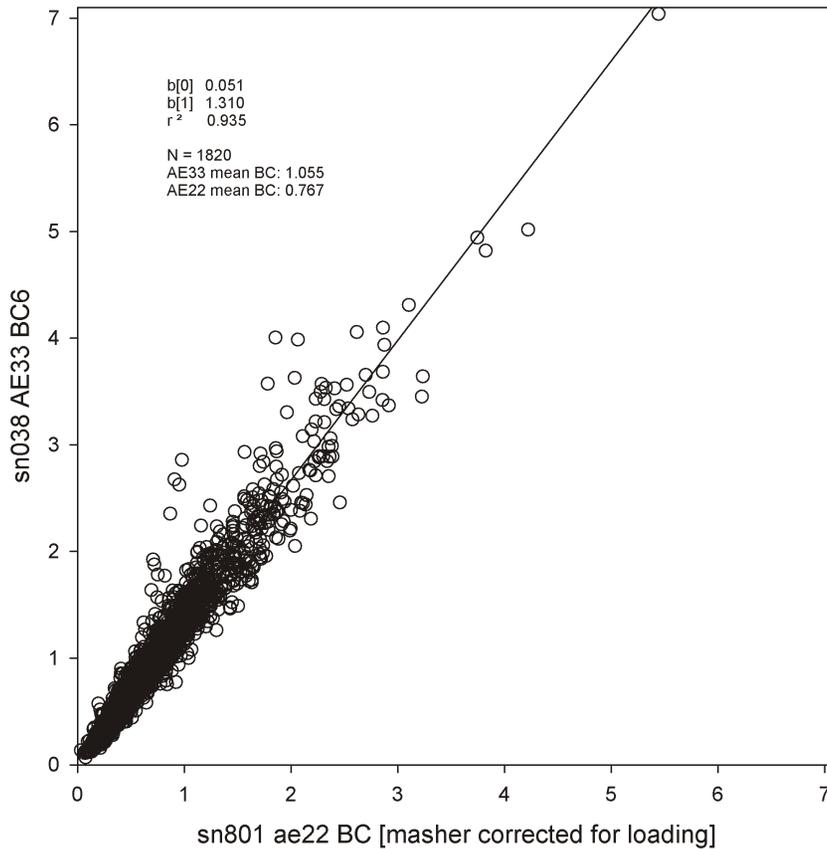
633 BC6 (880) expected to read higher than Legacy BC
~10 to 15%
compared to uncorrected legacy BC (880)
site and season-specific

May read substantially higher ~30% [??]

Examples of 633 BC6 vs. Legacy “corrected” BC(880): Roxbury/Boston MA (MassDEP), and Rochester NY (NY-DEC)

Roxbury: slope=1.31

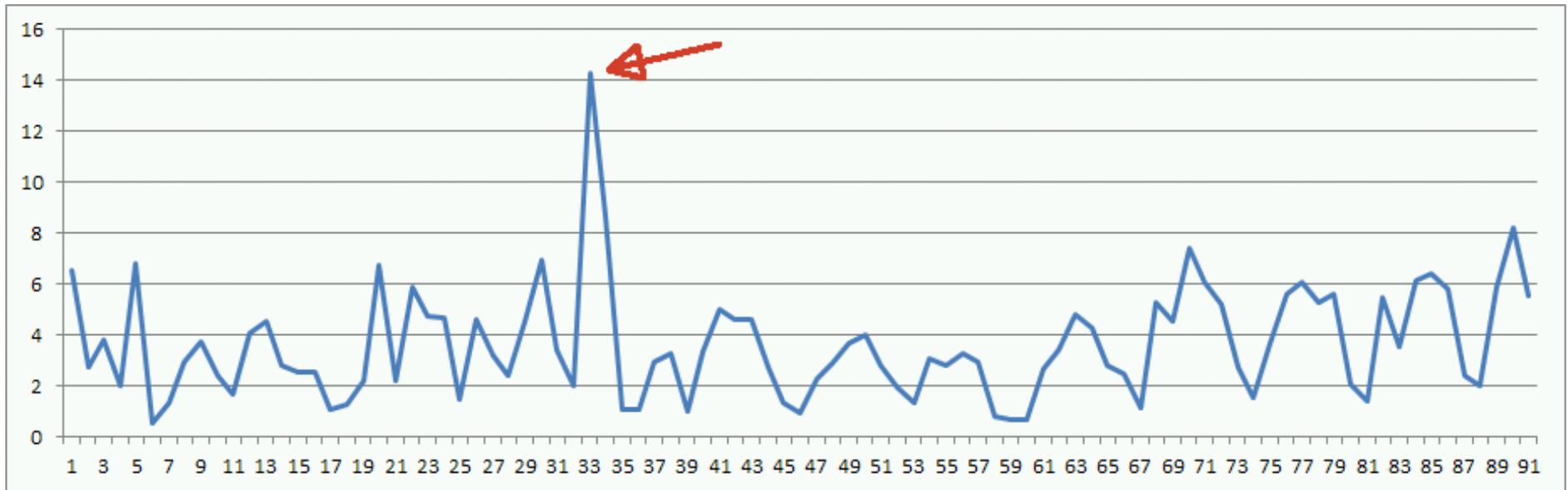
Rochester: slope=1.28



QC Suggestions - Data Screening

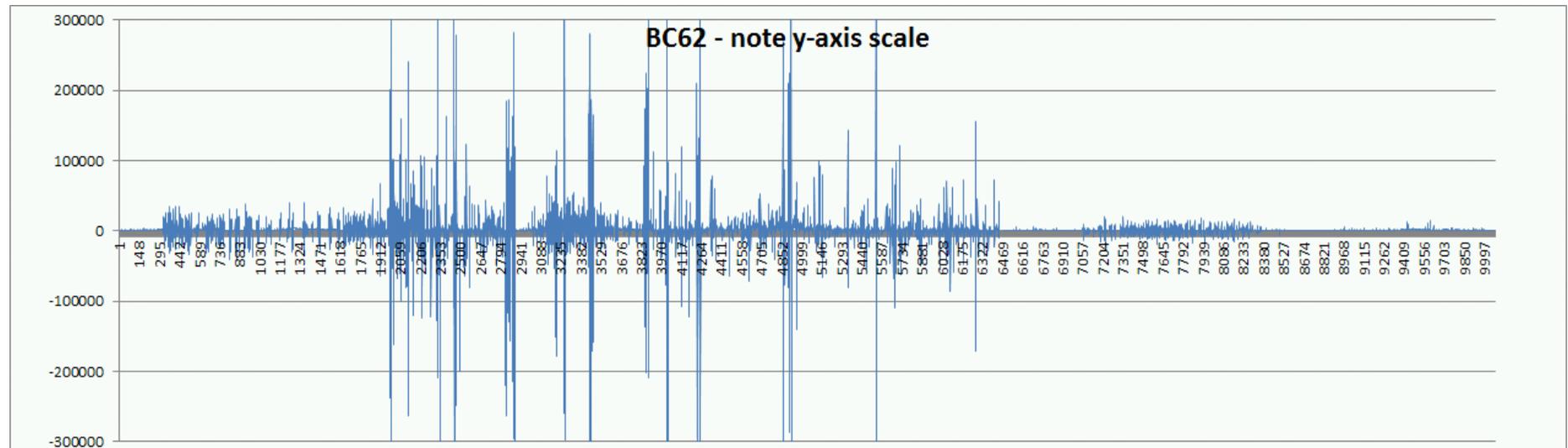
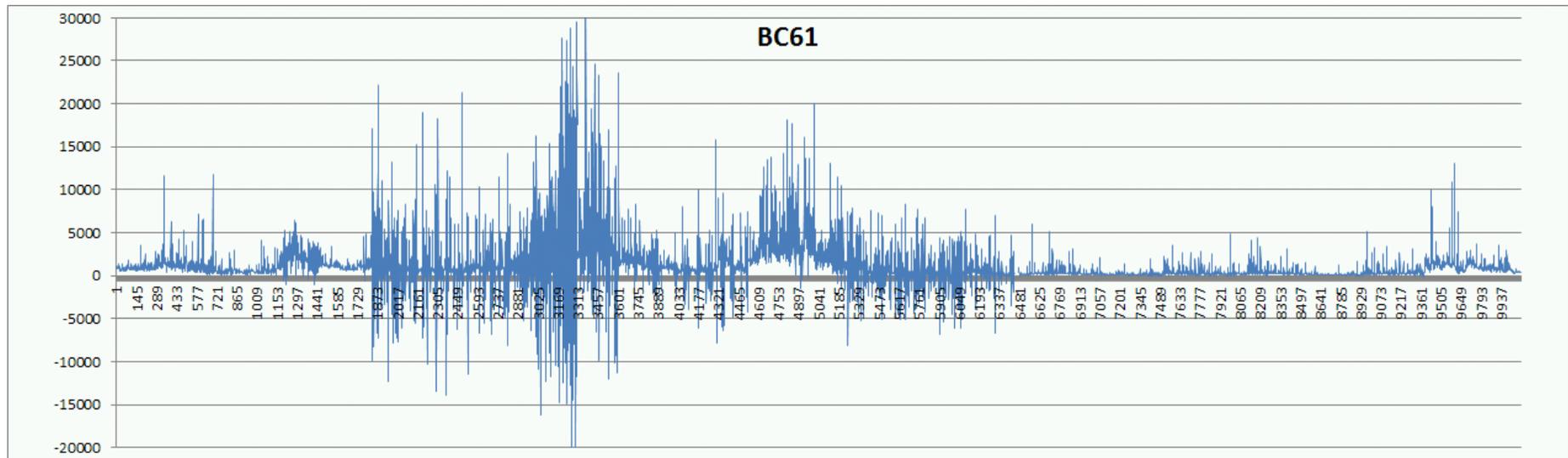
BC time-series at 1-min. and/or 1-hour level
Noise, Extreme values

Real-World Case Study: Daily Max 1-h BC from ANT (3-months)



14 $\mu\text{g}/\text{m}^3$ 1-h BC6? Investigate...

Quick QC plot of 1-minute data for 1-week period in question:



K6 for this 1-week period:



Indicates serious operational problem (invalid data)!

K6 is normally between 0.000 and 0.006

Default K Min/Max: -0.005 to + 0.015

Cause: junk on spots [bugs can get past cyclone]

High K (+0.015) results in over-correction of data

Not obvious from casual review of 1-hour average data

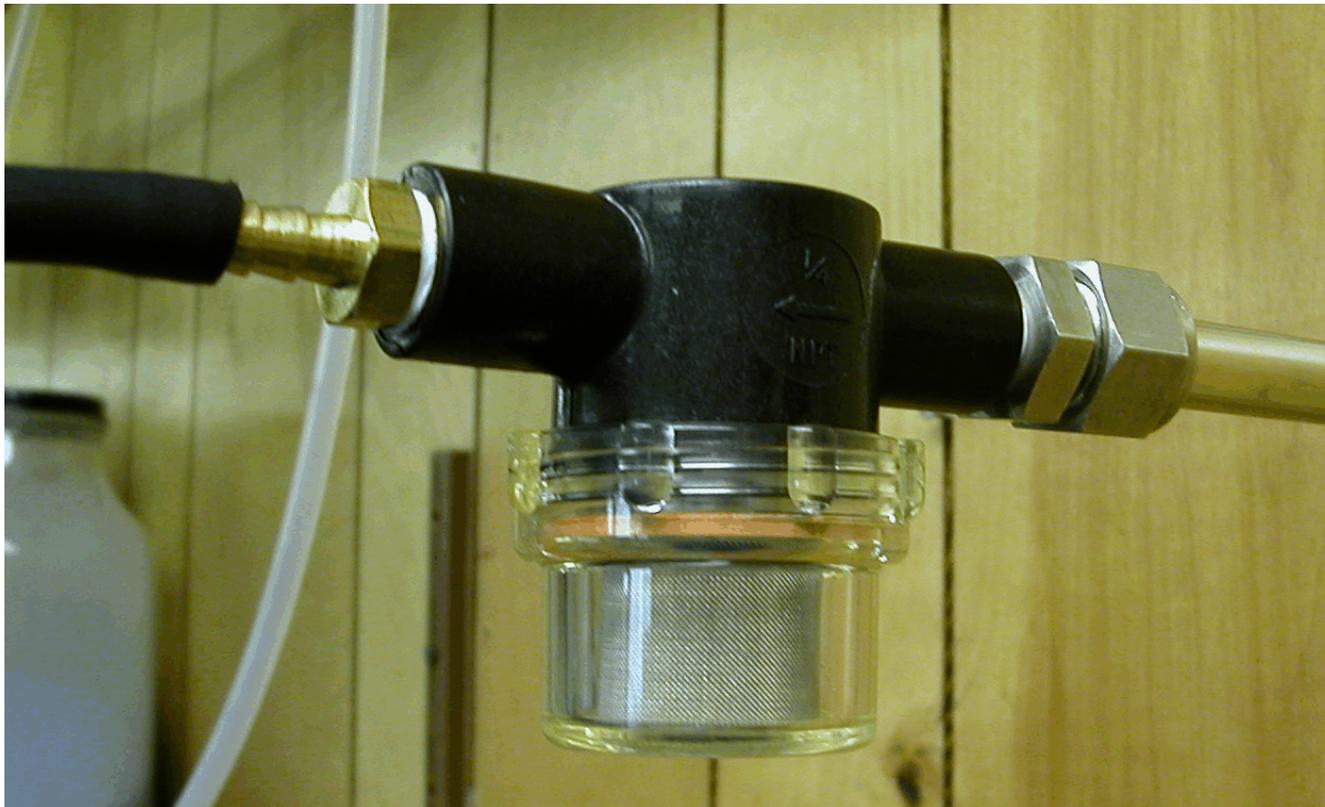
Bugs, Bugs, Bugs... (Real, not software)

633 method is sensitive to “stuff” on filter spot

Causes problems with calc. of K

Legacy Aeth 1-h data was usually ok when 1/5 min data noisy

Solution: Bug Trap on inlet!



Supplied by TAPI

Critical to use!!!

Water trap too.

See Magee or TAPI
booths if you need
one.

Bugs, Bugs, Bugs... (Software, not real)

Instrument software before version 1.1.0.0

“ATN-0” bug

Can cause very large spurious data
that can effect calc. of K

that can effect reported BC for hours/days

TAPI pushed 1.1.0.0 out on CF card Spring 2014

Important to “install” (swap CF card)

THEN: install 1.1.3.0 per manual upgrade instructions

→→ **ONLY** if 1.1.0.0 is already installed!!

Fixes CET “summer” time issue

633 time changes 1-h March/Oct AFTER reboot

1.1.3.0 allows time-zone set and DST on/off

Many other minor improvements!

Data Tools

Two Tools for data collected before ver 1.1.0.0

Available from TAPI API-CustomerService@Teledyne.com

1. 1-minute reprocessor

Input is raw daily 1-minute data files

Output is “corrected” 1-minute data files

Fixes ATN-0 data corruption

Not needed for ver. 1.1.0.0 or higher

Instrument software is in header of each daily data file

2. 1-hour Averager

Input is raw daily 1-minute data files

Output is 1-hour average for 7 BC channels

Includes % valid for each hour

Use to validate logger data!

Things To Be Aware Of

In no particular order...

Push “Status” indicator to decode error message (1.1.0.0 and later)!

Agilaire Airvision 633 module fix to exclude “0” invalid data
633 outputs “0” for data during tape advance or flow checks, etc.

Work-around released last month:

<http://www.agilairecorp.com/support/633.zip>

Time-set Command now stops and re-starts 633.

Don’t issue daily (uses up tape) - Monthly?

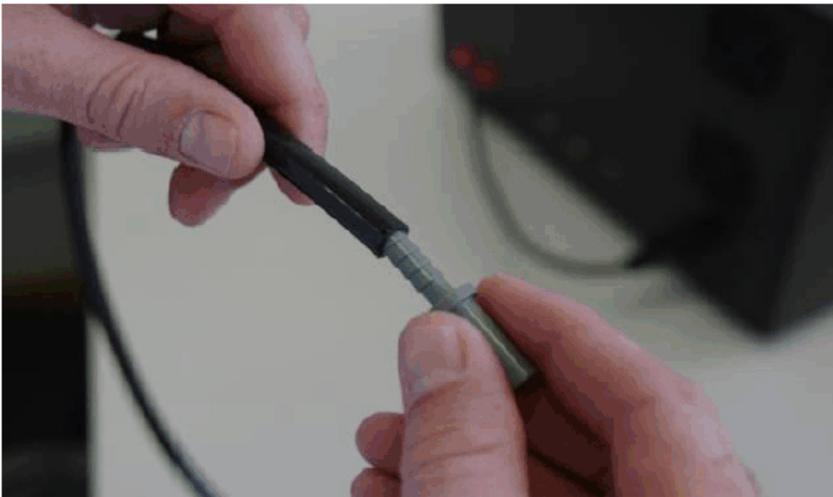
Do not change flow to 2 lpm - stay at 5 for now.

unclear if different flow calibration is needed

Quick-Connects and soft conductive tubing: bad combo

Very easy to not seat properly!! → 3/4" rule

TAPI supplies barb adaptors - use them (on inlet cyclone too)

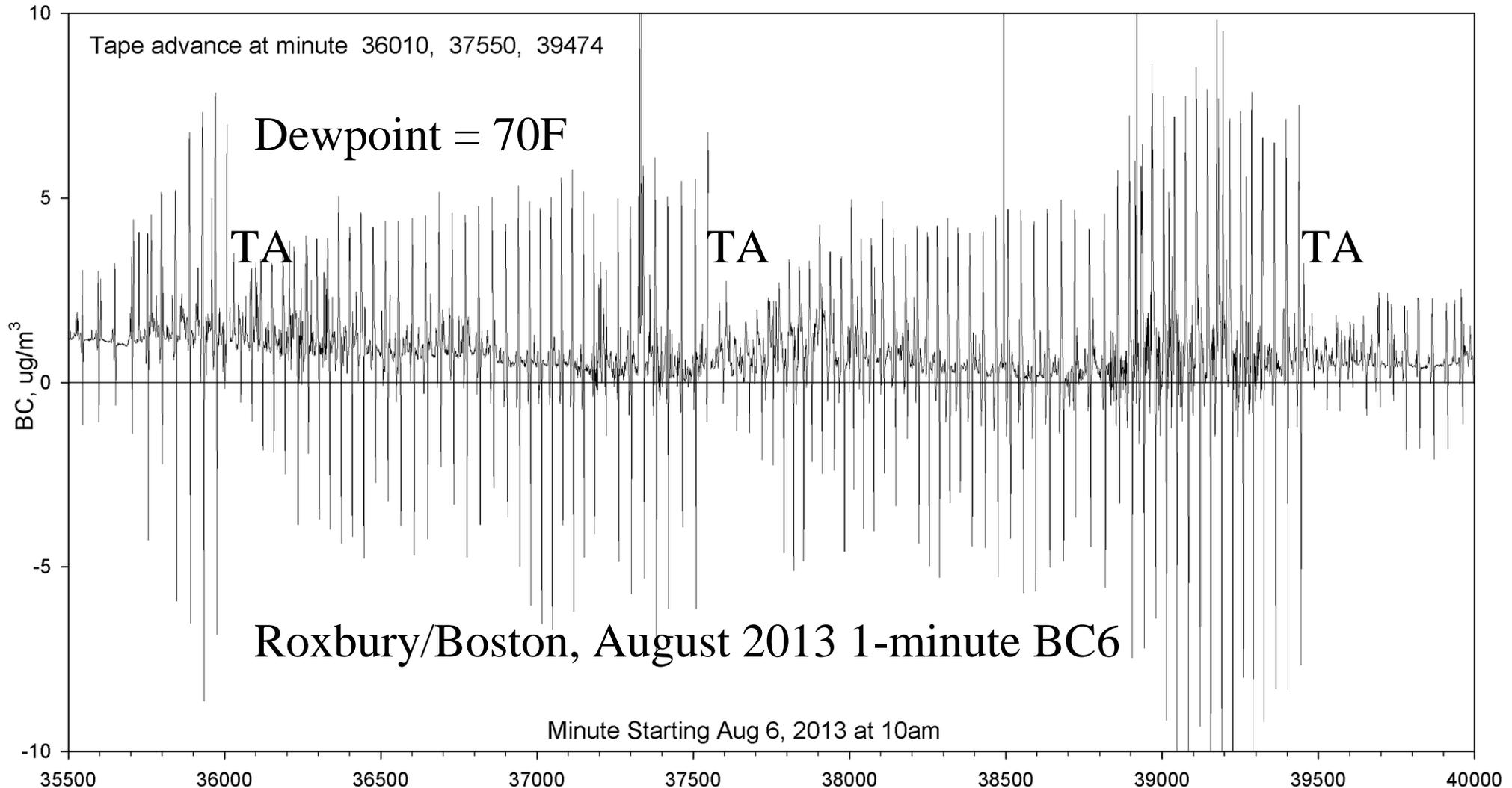


RH cycling effect (from air conditioner cycling)

Teflon tape fixes media effect; still have aerosol effect in 1-min. data

Hourly data are ok -- but ONLY IF negative data are included

A sample dryer option will be available



CONCLUSIONS

- 633 Aethalometer is a robust instrument
- Important to run latest 633 software
data with pre 1.1.0.0 may need reprocessing
- Software tools available from TAPI
- Should do some level of data review / QC screening
- Always do a FV before a Flow Cal
- Validate logger data with instrument data
- Bug trap and hose barb connectors are important to use
- Do collocation with legacy Aeths
- RH effect is still present at 1-minute data level
1-hour data are ok

ACKNOWLEDGMENTS

MassDEP for loan of production 633s and Roxbury data

TAPI, Magee Scientific, and Aerosol for technical and travel support

Ljubljana at night

