

TSI 3783 Ambient Water CPC for Routine Particle # / UFP measurements:

Are we there yet?

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The Problem:

Routine ambient “UFP” monitoring is needed soon

UFP == total particle # concentration (#/cc)

[no sizing info, down to < 10 nm diameter]

For Near-Road, other combustion-oriented sites

Existing methods (“CPC”) are not robust, not simple

Example: TSI 3022a butanol CPC

Can provide good data; research tool

Recent Progress: TSI (Hering/Quant) Water CPCs

No Butanol!

First round didn't work very well (Ex: 3781)

The Solution?

TSI model 3783 water CPC

Released Spring 2010; ~ \$24k.

Designed from the start for routine long-term ambient use

Input from several beta testers (thanks Phil F, Jim S!)

Got many ugly bugs fixed

Meets most requirements for ambient # conc. monitoring:

Down to < 10 nm

Up to 10^6 /cc (no photometric mode)

Fast response

Short sample residence time (3 lpm inlet flow)

(minimize diffusion losses)

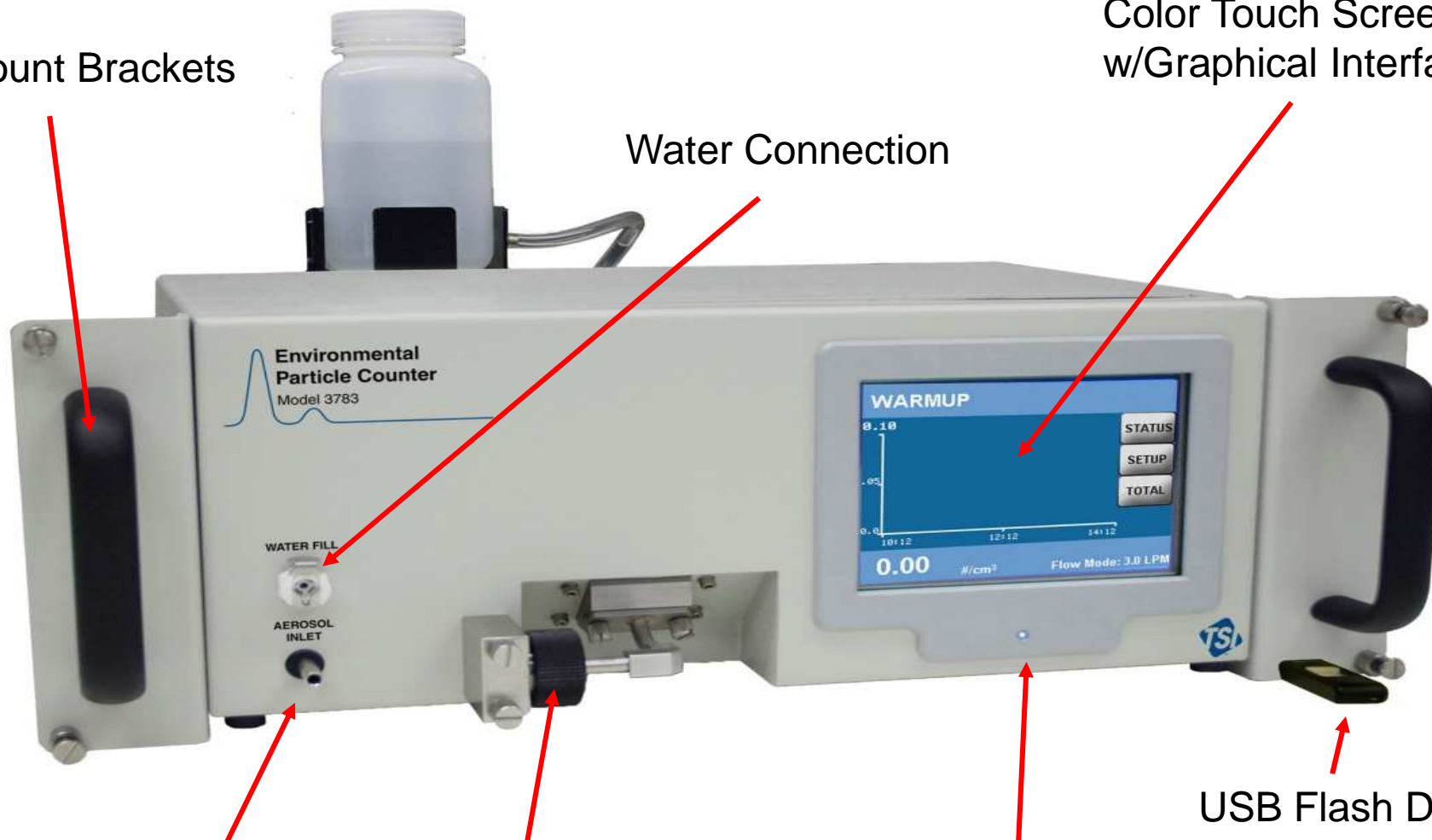


Front Panel

Rack Mount Brackets

Color Touch Screen
w/Graphical Interface

Water Connection



Inlet

Inlet Screen Assembly

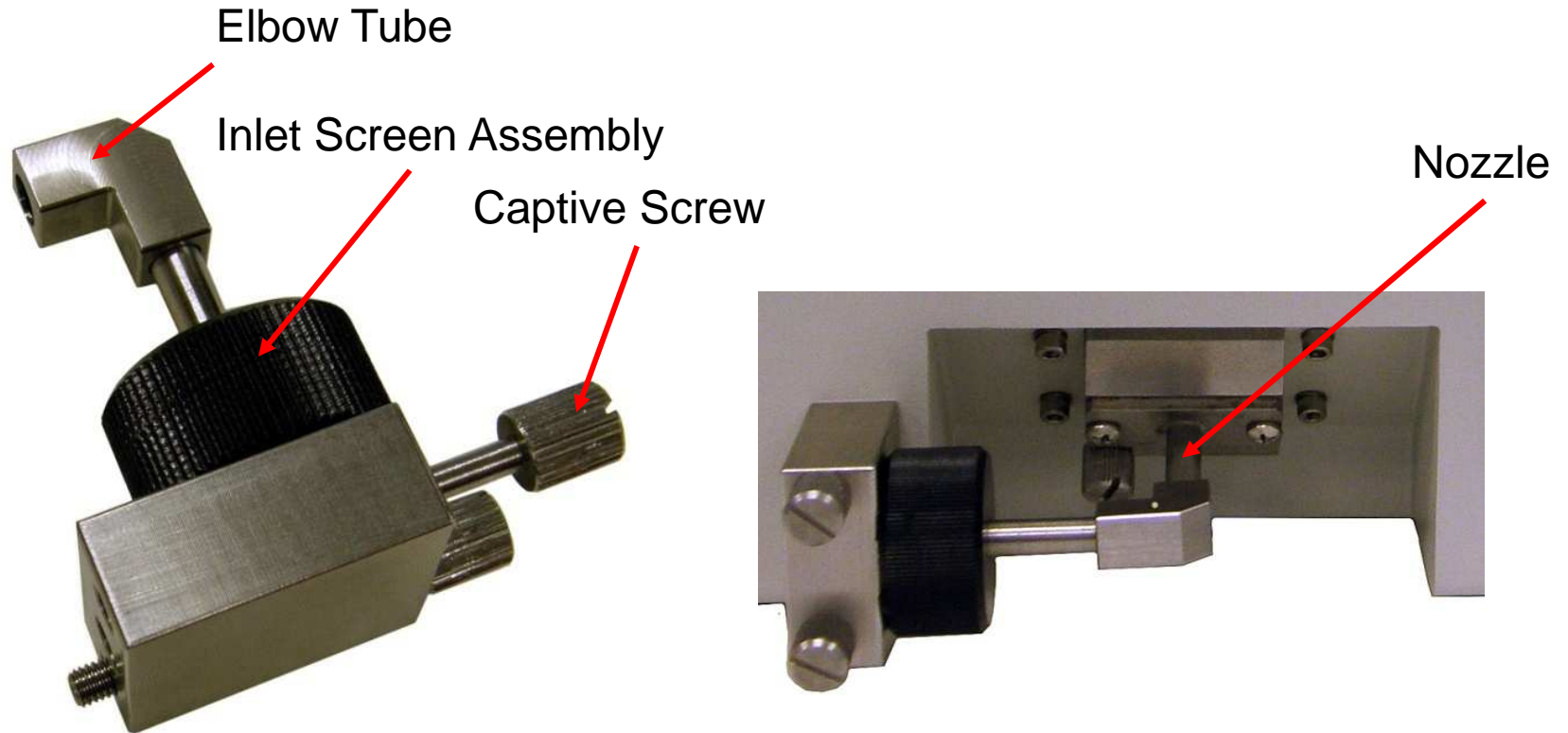
Status LED

USB Flash Drive



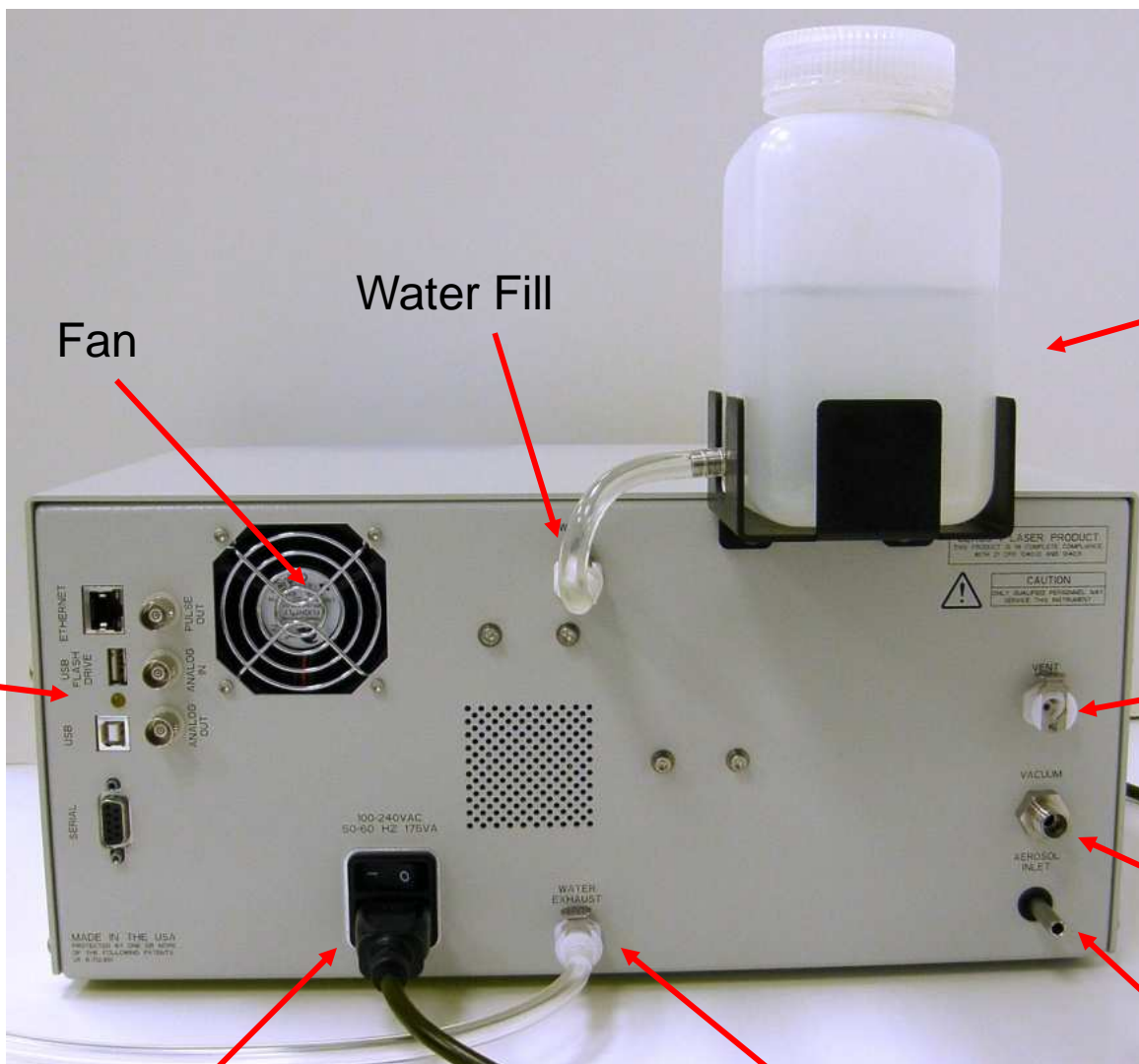
Inlet Screen Assembly

The inlet screen assembly prevents large matter (i.e. insects and dirt) from entering the instrument





Back Panel



Water Bottle & Bracket

Water Fill

Fan

Data Communication Ports

- Ethernet
- USB
- RS232
- Pulse Out
- Analog In
- Analog Out

Water Supply Air Vent

Vacuum Source

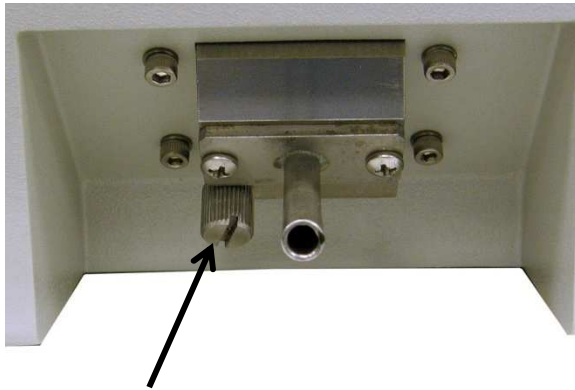
Power Supply

Water Drain

Aerosol Inlet



Wick Removal 1,2,3



1. Unscrew Jack Screw & remove wick assembly

2. Unscrew Wick Cartridge



3. Unscrew wick cartridge to remove the wick



EPC Specifications



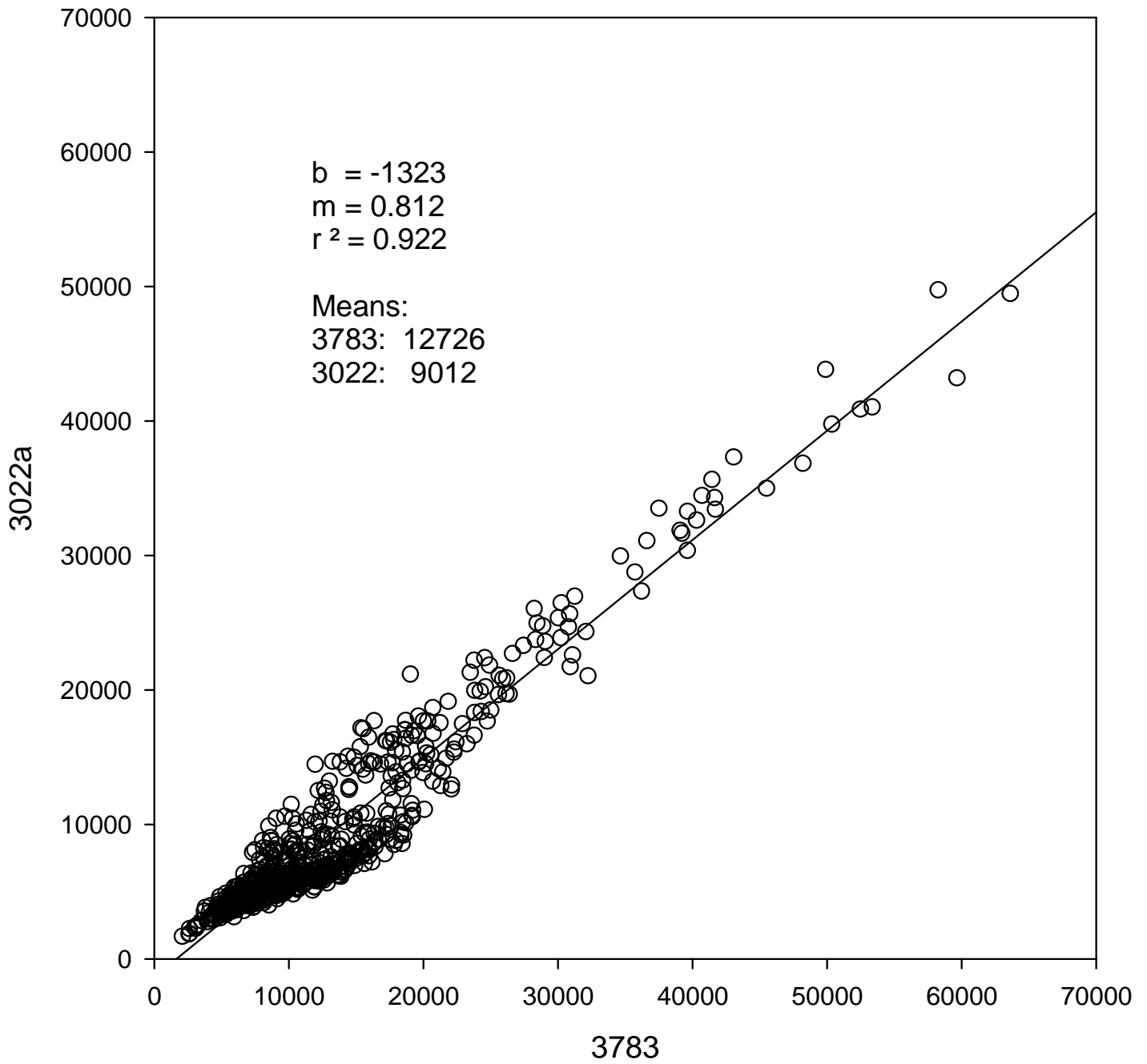
Min. Detectable Particle (D50)	7 nm, verified with DMA-classified sucrose
Particle Concentration Range	0 to 10 ⁶ particles/cm ³ Single Particle Counting
Particle Concentration Accuracy	±10% at 10 ⁶ particles/cm ³
Flow	
High-flow Inlet	3 ±0.3 Liters/minute
Low-flow Inlet	0.6±0.06 Liters/minute
Aerosol Flow Rate	120 ±12 cm ³ /minute
Ambient Temperature Range	10 to 40 °C (50 to 104 °F)
Water System	External 500ml bottle for up to 1-week operation. 4L fill bottle for up to 4-week operation (optional accessory)
Water Consumption	250 ml/week
Vacuum	External vacuum; pump not included
Calibration	Recommended annually
Power Requirements	100 to 240 VAC, 50/60 Hz, 175 W maximum
Physical Features	
Dimensions (HWD)	8"x19"x12"
Weight	9.9kg (22lbs)



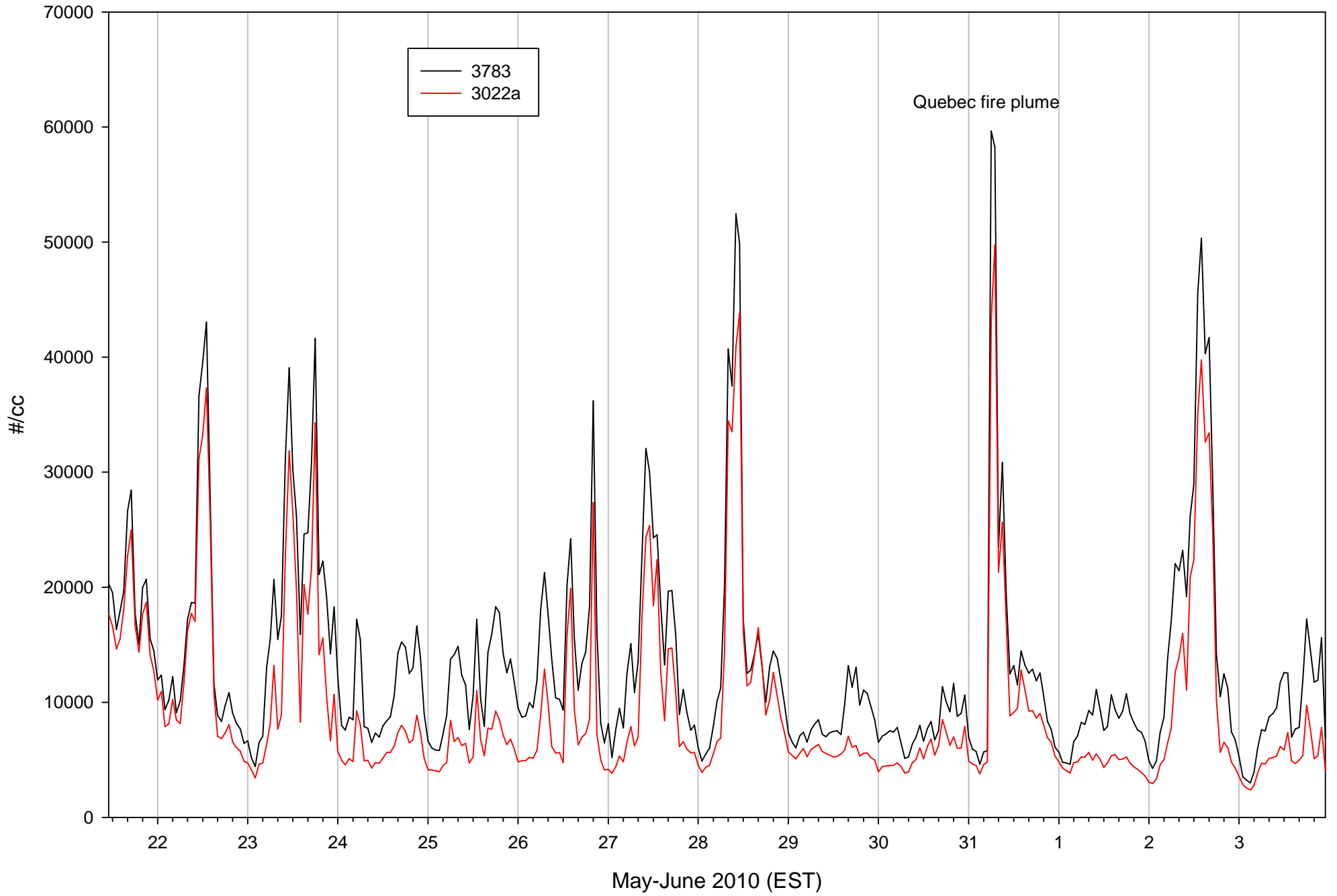
Recommended Operating Procedures

- 1. Use the Quick Start Guide and Read the Manual**
- 2. Standard Operation Procedures (every 2 weeks)**
 - Fill water bottle with distilled or ultrapure water - do not use tap water
 - Check status screen, inlet pressure, time and date on the USB flash drive
 - Check/clean the inlet screen
- 3. Outdoor Operation Procedures**
 - Conditioned enclosure (hold T & P specs)
 - Heat or insulate the sample line (to reduce sample condensation)
 - Use a PM inlet or a cyclone (with a cut size no greater than $\sim 3 \mu\text{m}$)
 - Inlet pressure differential not greater than 2.5 kPa (10" of H₂O)
- 4. Annual Maintenance**
 - Replace the filters
 - Replace the wick
 - Check flows
 - Perform a zero check

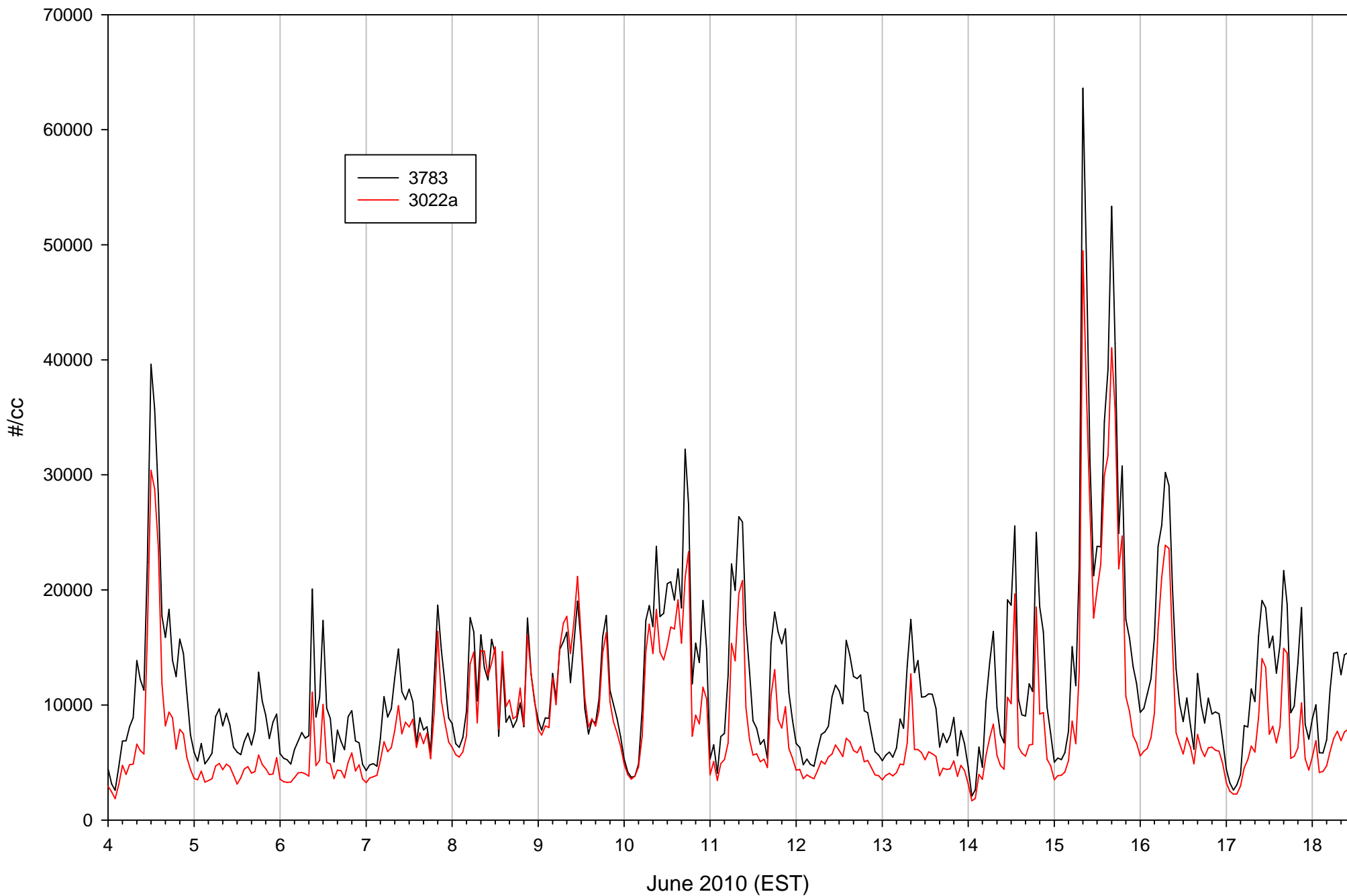
CPC Collo, HSPH Boston Countway Library PM-Center Site
1-hour Means, May 21 - June 18, 2010



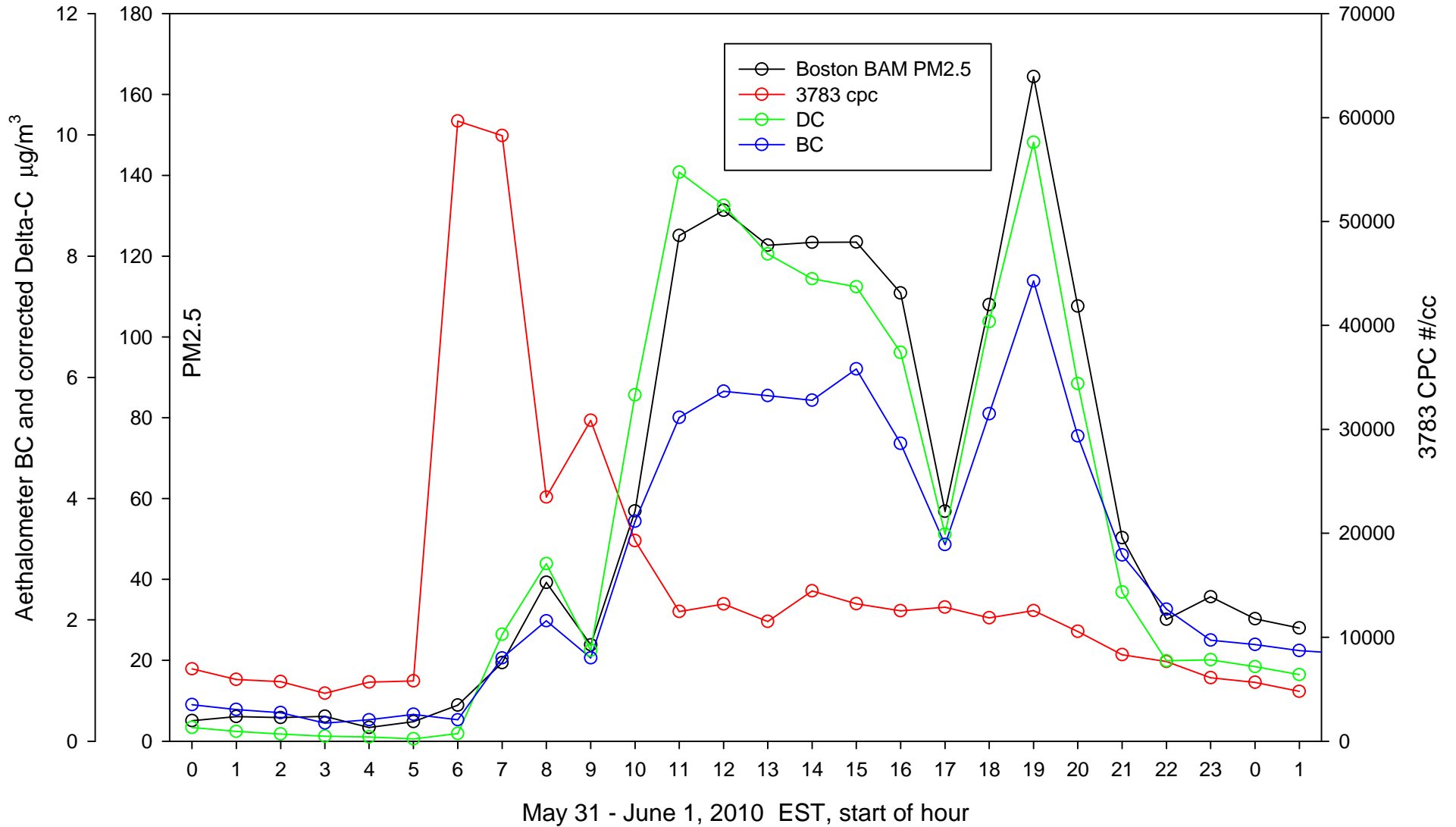
3783 and 3022a CPCs, 1-h means - Countway HSPH site



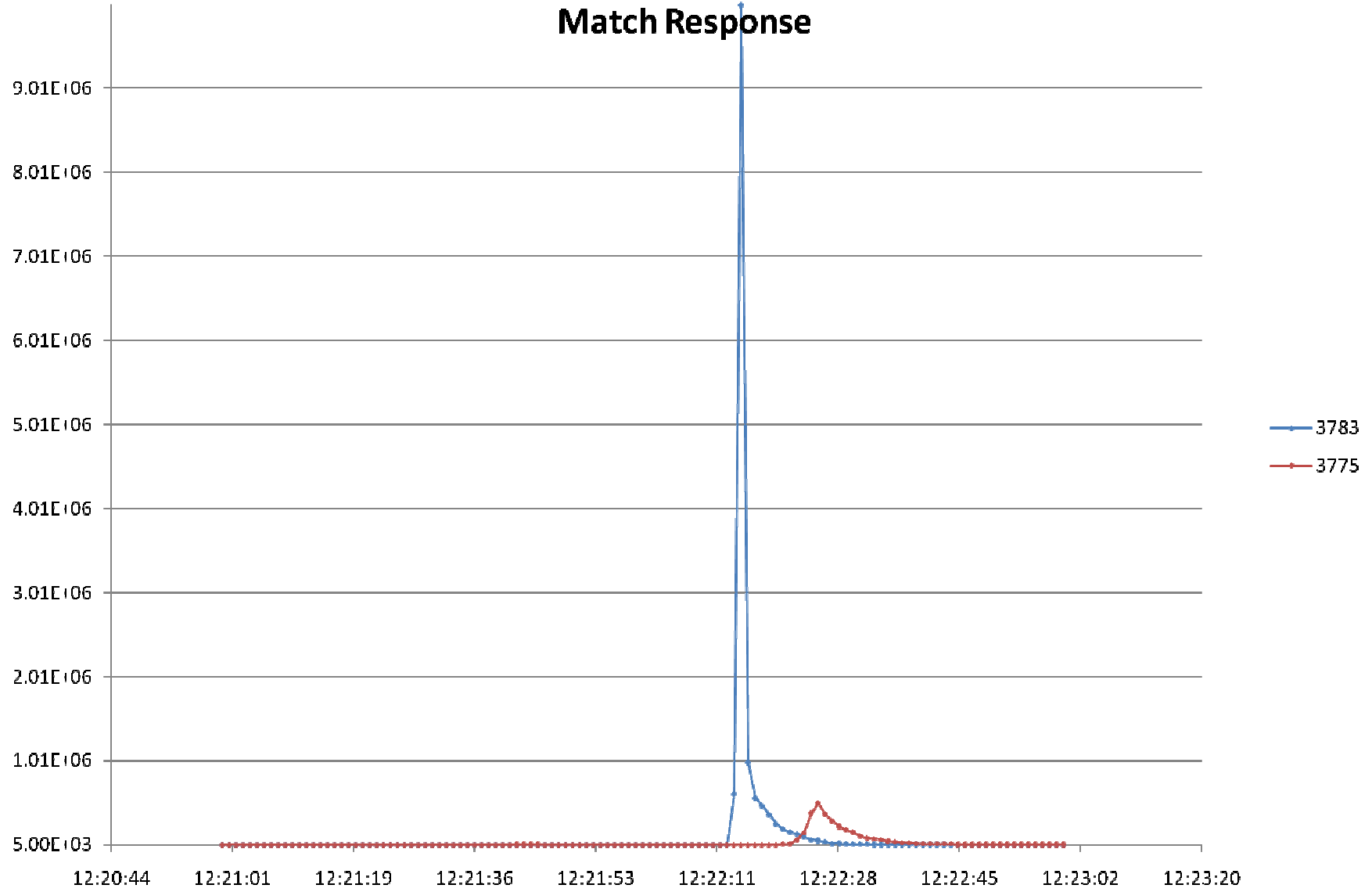
3783 and 3022a CPCs, 1-h means - Countway HSPH site



Boston Quebec Fire Event -- Hourly PM2.5, Aeth DC, and # conc
 PM2.5 is average of N.End and Roxbury MA-DEP sites



Match Response



SETUP

1. Turn 3783 power on; needs ~15 minutes warmup.
2. Connect drain bottle and place 2 ft. below instrument.
3. Connect vacuum pump to exhaust port [not to the inlet port - easy to do...]
4. Connect inlet line to inlet port [make sure the unused inlet is capped]
5. Connect 1/2 liter water supply bottle filled with MQ or DI water and place above instrument.
6. Plug in "clean" usb thumb drive. Push "Start" on touch-display to log data.

Setup parameters:

Time = 60 sec (one data record per minute)

Flow = 3 lpm

Logging = daily (one data file per day)

Clock: set to EST using touch screen controls

OPERATION

Daily or each site visit:

Check water level in supply bottle; refill if less than 1/3 full (full bottle lasts ~ 2 weeks)

(Empty drain bottle if more than 1/2 full)

Check that CPC display shows:

"Logging" in lower right

"READY" in upper left

-- a reasonable 2-hour data plot

Weekly or as needed:

Change the USB memory stick and check/reset CPC time:

Press Stop on touch-display

Swap USB sticks

Check instrument date/time [Setup menu] and reset if >30 seconds from site time

Press Start

AFTER A POWER FAILURE:

Push the "Start" button on the display.

(The CPC will not start to log data to the usb mem stick after a power failure.)

To Drain [before moving or shipping]:

1. Disconnect water supply bottle.
2. Run instrument for ~ one hour, until display says "low water" and counts drop towards zero

Does It Work?

Yes. No significant problems during short-term tests.

How reliable? Don't know yet.

Need longer term field testing

Things to Consider:

Keep inlet line very short: < 12-16 inches!

Issues with true collo of other instrument inlets...

Run at 3 lpm inlet flow (minimize residence time)

Use inlet cyclone (BGI SCC0.732, 0.6 μm at 3 lpm)

<http://bgiusa.com/aam/sccphoto.htm>

Keeps boulders out of the instrument