## Promising New Technologies for Air Quality Monitoring

Ken Stroud Air Quality Surveillance Branch Air Resources Board PQAO Training July 27. 2015

### **Auto Calibration System**

- Features
  - Internal Photometer
  - Flow rate feedback
  - Ethernet communications







www.shutterstock.com 86469949

### **Auto Calibration System**

DATE	TIME	cal	Dilluent Flow	Dilluent Set	Gas_Flow Ctrl	Gas_Flow Mon	O3_Conc_Ctrl	O3_Conc Mon	O3_Lamp Ctrl	O3_Lamp Mon	Photo_O3 Conc
1/25/2015	3:52:00	66	9.995	10	0	0	0	0	0	0.005	0
1/25/2015	4:02:00	11	9.999	10	0	0	0	0	0	0.005	0
1/25/2015	4:10:00	66	10.001	9.978	22	21.8	0	0	0	0.005	0
1/25/2015	4:20:00	12	9.978	9.978	22	22	0	0	0	0.005	0
1/25/2015	4:28:00	66	9.978	9.978	22	22	0	70	0.449	0.447	0
1/25/2015	4:38:00	13	9.979	9.978	22	22	0	70	0.449	0.447	0
1/25/2015	4:46:00	66	10.004	10	0	0	70	70	0.449	0.448	73
1/25/2015	4:56:00	14	10.003	10	0	0	70	70	0.449	0.449	67
1/25/2015	5:04:00	66	0.176	0	0	0	0	0	0	0.005	0

## Direct NO<sub>2</sub> Measurement

- Direct measurement Cavity Attenuated Phase Shift (CAPS)
- No catalytic conversion and no O<sub>3</sub> generation, which can introduce artifacts
- Reduced maintenance items
- EPA designated equivalent method
- Will Data Users be OK w/o NO & NOx





# HiVol vs LoVol

Background

- ARB has a 30-year record of HiVol PM10 Nitrate measurements in the San Joaquin Valley which it would like to maintain.
- ARB is conducting a field comparison study of nitrate from a Hi-Vol PM10, Met One SASS Speciation PM2.5 and a Met One SASS Speciation PM10 samplers.

#### PM10 HiVol / PM10 SASS Nitrate Data 11/19/14 to 5/18/15



#### PM10 HiVol vs. PM10 SASS Nitrate Data 11/19/14 to 5/18/15



## PM2.5 Speciation; Carbon



Mimic IMPROVE Carbon method of sampling

- Requires 22 lpm airflow (instead of 6.7 lpm)
- Filter diameter 25 mm (instead of 47 mm)
- Head-To-Head comparison August 2015 thru March 2016.



## **Canister Sampling**

- Features
  - Touch screen display
  - Improved communications (Ethernet)
  - Multi-point flow calibration
  - More sample feedback (monitors sample flow during sampling)



### Web Cameras







### Rooftop Continuous PM2.5 FEM Mass Monitor





- U.S. EPA designated PM2.5 automated method
- Rooftop mounted .

### **Black Carbon**

- Employs a standardized EPA-style inlet system
- Calibrated against a physical mass standard



#### PM2.5 BC Time Series Graph 7/21/15 to 7/24/15



#### PM2.5 BC Time Series Graph 7/21/15 to 7/24/15



### **Condensation Particle Counter**

- Counts ultrafine aerosols by enlarging them with a working fluid so the particles can be easily detected
- Looking for district partners to deploy in near-roadway environments



## Cavity Ring-Down Spectroscopy

- Tunable Laser enters a cavity defined by two or more high reflectivity mirrors
- Miles of effective path length to maximize sensitivity (signal to noise ratio)
- Based on rate of decay or laser intensity absorption to calculate the gas concentration







## **Cavity Ring-Down Spectroscopy**

### **Collaboration with:**

- Advanced Global Atmospheric Gases Experiment (AGAGE)
- National Oceanic and Atmospheric Administration (NOAA)
- Berkley National Lab
- Livermore National Lab
- Jet Propulsion Lab
- UC San Diego



#### **Comparison of Measurement Accuracies**

(Sutter Buttes May 2015)



### **Boundary Layer Measurements**

New Instrumentation

- Mini-LIDAR
- Ceilometers







### **Boundary Layer Measurements**



# Real-time GC/MS for HFC Measurement

- Automated system measures HFCs, CFCs, HCFCs
- Modeled after Scripps Institute of Oceanography *Medusa* system
- Cryogen-free low-temperature preconcentration (-165°C)
- Twelve in situ ambient air measurements per day



## Conclusion

- Change is Constant and Inevitable
- Technological changes in air monitoring are mostly
  Evolutionary but sometimes
  Revolutionary

