

DEVELOPMENT OF TWO MOBILE MEASUREMENT STATIONS FOR AMBIENT AIR TOXIC MONITORING IN LOCAL COMMUNITIES

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INTRODUCTION

Background

- Multi-year Community-Scale Air Toxics Monitoring grant from EPA (November 2008)

Specific Objectives

- Develop two rapidly deployable mobile measurements stations (MMS) for ambient air toxics monitoring
- Characterize ambient air toxics levels in communities surrounding LAX and LGB
- Supplement a concurrent LAWA air quality study by providing additional capabilities for air toxics monitoring

Slide 2

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In November 2008, the Board recognized an award from a U.S. EPA Section 103 grant for a Community-Scale Air Toxics Monitoring study. The objective of this two-year study is to further characterize ambient air toxics levels in communities surrounding large commercial airports in the South Coast Air Basin. The study focuses on two of the Basin's large and expanding commercial international airports, Los Angeles International Airport (LAX) and Long Beach Airport. The work will supplement a concurrent Los Angeles World Airports air quality study by providing additional capabilities for air toxics monitoring at multiple locations in the surrounding communities. The monitoring efforts at both airports will be accomplished with a unique set of rapidly deployable mobile air toxics monitoring platforms using the latest technologies for air toxics measurements, including continuous instrumentation.

Andrea, 1/31/2011

MOBILE MEASUREMENT STATIONS DEVELOPMENT

MMS Characteristics

- Fast-response deployment
 - *Wide spatial coverage and rapid adjustment*
- Flexibility of operation
 - *Land-based power and self-contained generator or battery power*
- Gaseous and particulate pollutants characterization
- Multiple monitoring technologies
 - *Continuous (e.g. 1- to 5-min)*
 - *Integrated (e.g. 24-hr)*
- Address AQMD and community concerns
 - *Local impacts of pollution sources*

Slide 3

A17

The mobile platforms will be deployable on the time scale of hours rather than weeks, allowing for more spatial coverage and rapid adjustment to locations based on monitoring results. The platforms and equipment will have sufficient flexibility to operate on both land-based power and self-contained generator or battery power. A variety of traditional time-integrated methods will be combined with newer continuous low-power methods for air toxics measurements. When the U.S. EPA funded study is complete, the AQMD will deploy these two new monitoring platforms to address AQMD and community concerns related to local impacts of pollution sources.

Andrea, 1/31/2011

MOBILE MEASUREMENT STATIONS DEVELOPMENT

Particulate Matter

Gaseous Species

Wind System



Slide 4

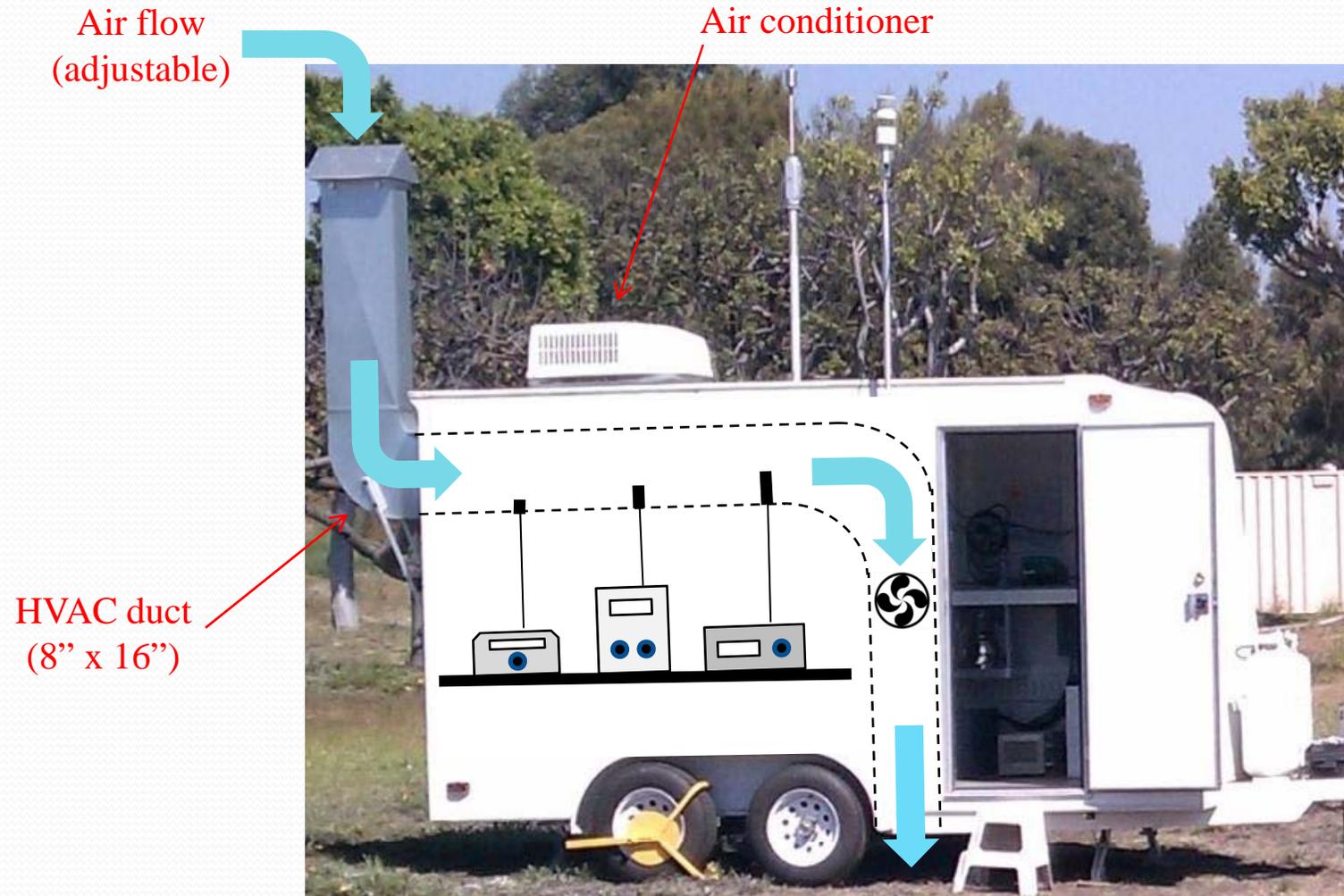
a23

Mobile Measurement Station (MMS) comprised of a 14 foot dual axle trailer equipped with a wide array of air quality measurement instruments

apolidori, 1/28/2011

A18 A20

MOBILE MEASUREMENT STATIONS DEVELOPMENT



Slide 5

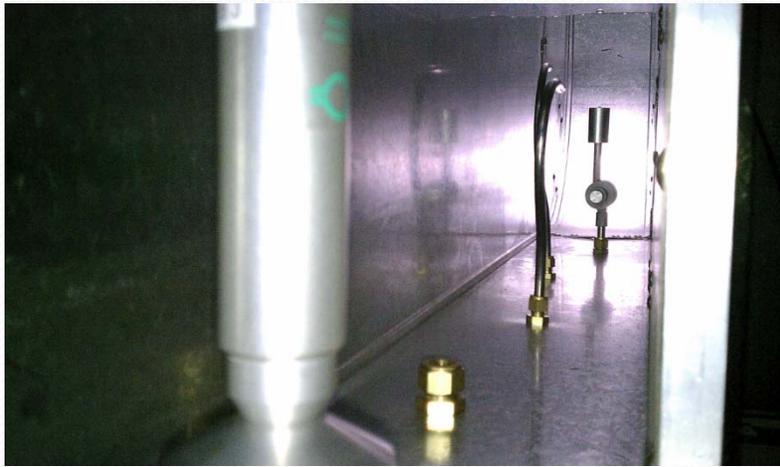
A18 To achieve optimal sampling conditions the inlets of all particulate instruments are mounted inside a 0.2 m wide x 0.4 m high (standard 8" x 16") HVAC duct, which is equipped with variable speed DC fans and has no air flow restrictions from the inlet to the exit. The inlet duct, elevated to 3.8 meters from the ground, maintains a 0.4 meter radius curve before entering the MMS. Each instrument's inlet is either centered or offset from the center of the duct by 2.5 cm (1 inch) to minimize air stream shadow effects from the previous inlet head.

Andrea, 1/31/2011

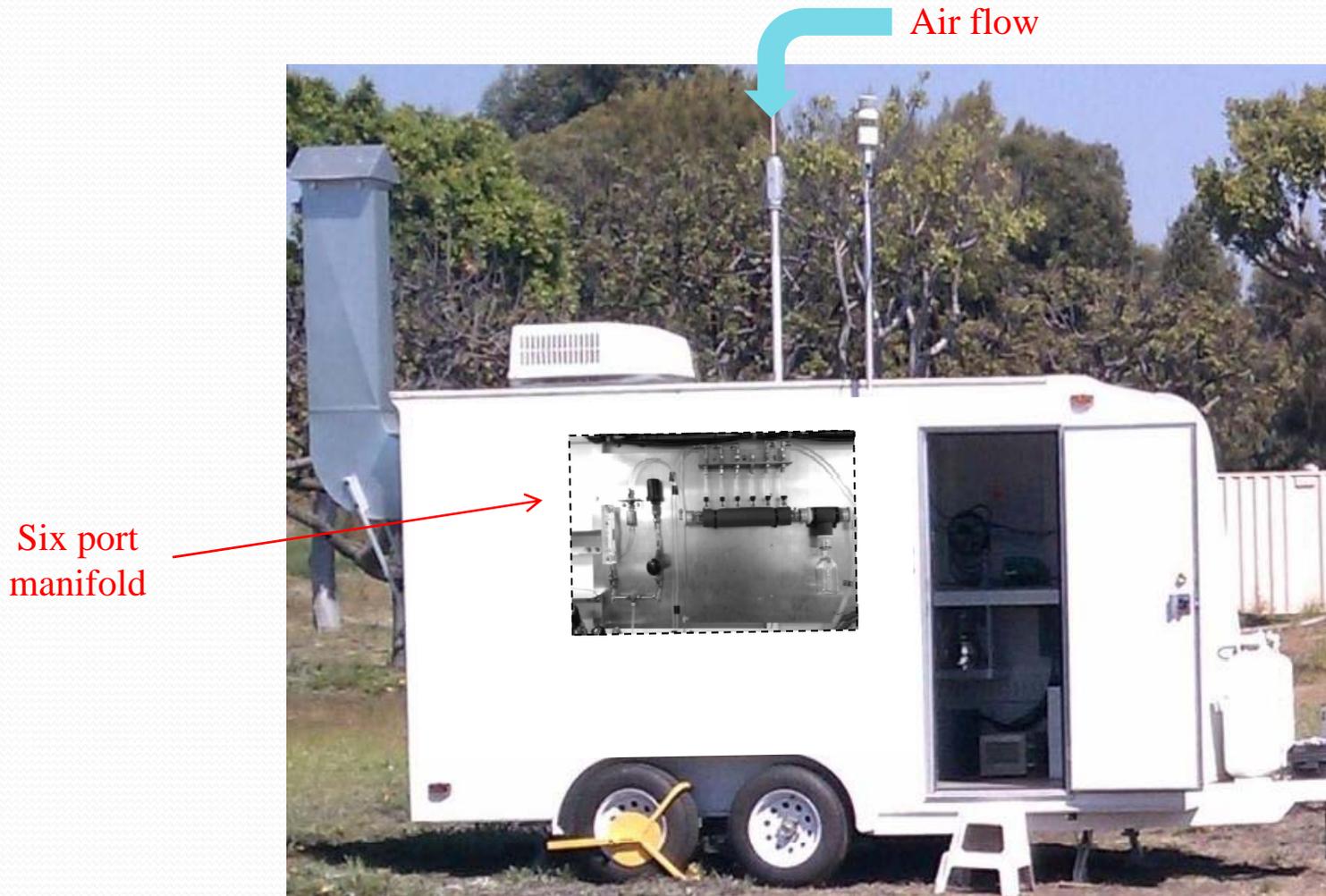
A20 The Particle Loss Calculator (Von der Weiden, et al., 2009) was implemented to achieve isokinetic conditions for 3/8" tubing inlets utilized for both the CPC and the DustTrak DRX. To attain these calculated values a Dwyer 641RM-12-LED air flow velocity meter has been implemented to measure air velocities at several points in the manifold. These variable fans are the only constituent of the particulate collection system, other than the CPC, without an internal power supply. An added gel-cell battery supplies power to the variable fans during power loss events; this gel-cell battery also provides back-up power to the Climatronics All-In-One weather sensor

Andrea, 1/31/2011

MOBILE MEASUREMENT STATIONS DEVELOPMENT



MOBILE MEASUREMENT STATIONS DEVELOPMENT



Power options: Shore power, Battery bank, and Propane generator; (Solar panels)

Slide 7

A12 The MMS (Figure 1) also allows for measurements of gaseous species via a modified permanent station gaseous manifold inlet. A rotating inlet rises to 4.3 meters in operation mode and is in-line with a standard 6 port Pyrex glass station manifold.

Andrea, 1/31/2011

A22 Power for the MMS is provided via 220 Volt shore power, a propane generator, or a bank of 8 deep cycle batteries wired at 24 Volts. The Magnum ME-AGS (Auto Generator Start) monitors the battery bank voltage, and initiates the generator start as the battery voltage drops to a given level, nominally set at 20 Volts. Generator operation during certain times of the day (i.e. nighttime in residential areas) may be limited due to noise concerns. Our solar panel option is not available at this time, but optimally six 195 Watt solar photovoltaic panels or flexible panels totaling up to 350 Watt will be installed. The 1170 Watt rigid solar panels will be equipped with a second air conditioner (600 Watt DC) to eliminate the impact of direct solar heating. Cooling the MMS is a primary energy-use requirement and when shore power is unavailable, the air conditioner only operates in series along the generator powered AC to DC inverter. As a result, not just voltage but interior temperature is an initiator for the ME-AGS and starts the generator at 90 °F (31.5 °C).

Andrea, 1/31/2011

MOBILE MEASUREMENT STATIONS DEVELOPMENT

Instrumentation

- Continuous

- *DustTrak DRX (TSI, Inc.): PM_{10} , $PM_{2.5}$, PM_{4} , PM_{10} , and TPM ($\mu\text{g}/\text{m}^3$)*
- *w-CPC (TSI, Inc.): UFP ($\#/ \text{cm}^3$)*
- *Aethalometer (Magee, Inc.): BC ($\mu\text{g}/\text{m}^3$)*
- *NOx Monitor (2B Technologies): NO, NO₂, and NOx (ppb)*
- *Baseline-Mocon Series 9000 (Mocon, Inc.): Methane and NMHC (ppm)*
- *Syntech Spectras GC (Syntech, Inc.): Individual organic compounds* a15
- *Q-Trak (TSI, Inc.): CO and CO₂*
- *Weather Station (Climatronics, Inc.): T, RH, WS, WD, and P*

- Integrated

- *BGI (Omni, Inc.) filter-based PM sampler*
 - *Speciated analysis*
- *Xontech multi-canister sampling (Xontech, Inc.)* A13
 - *VOCs*

Slide 8

A13 ...allows for triggering the collection of Silonite lined canister samples at user defined levels programmed with a Barix Barionet 100 PLC.

Andrea, 2/1/2011

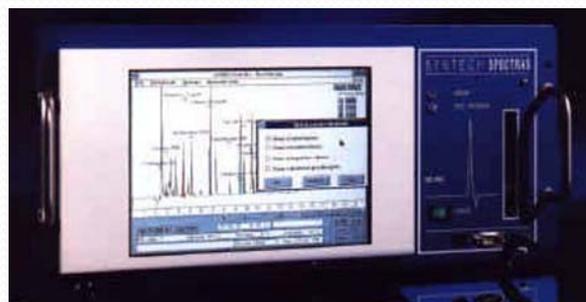
A23 The MMS is equipped with two BGI (Omni instruments), filter-based particulate samplers that are supplied with an interchangeable orifice to allow selectable measurements of TSP, PM10, PM4, PM2.5, or PM1. A DustTrak DRX (TSI, Inc.) measures the mass concentration of different size fractions of PM continuously. Further particulate measurements are achieved with a Condensation Particle Counter (CPC, model 3781; TSI, Inc.), which monitors UFP down to 6 nm and in concentrations of up to 500,000 particles per cubic centimeter (#/cm³). A portable Aethalometer (Magee, Inc.) for real-time measurements of BC was also installed.

Andrea, 2/1/2011

a15 complements the NMHC and is equipped with either a 1 to 6 or 7 to 12 carbon chain column depending on the focus of the study.

apolidori, 1/28/2011

MOBILE MEASUREMENT STATIONS DEVELOPMENT



AIT TOXICS MONITORING IN COLTON

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a26

a20



- **Sampling location:** proposed recreational park

- **Sampling period:** 02/16/10 to 04/07/10

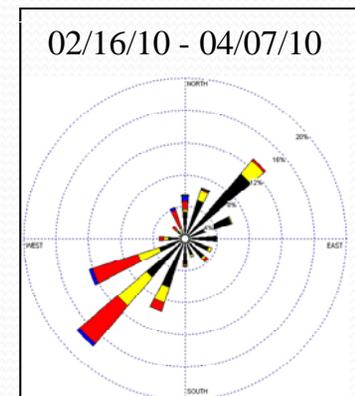
a22

- **Objective:** determine I-10 / I-215 emission contributions

- **Pollutants measured:** PM₁₀, UFP, and BC

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a25



a47

WIND SPEED (mph)

- >= 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 1.38%

Slide 10

- a20** This area is situated in a flood plain near the intersection of two major freeways (the I-10 and I-215), both characterized by heavy vehicular traffic.
apolidori, 1/28/2011
- a22** The main objective of this field campaign was to evaluate the extent to which motor-vehicle emissions from the I-10 and the I-215 influence air quality at the proposed park site. Proximity to a freeway could potentially lead to increased exposure to one or more combustion-related pollutants and an accurate assessment of local air quality conditions before the beginning of the construction project will allow the city to better evaluate the extent of such exposure.
apolidori, 1/28/2011
- a25** A weather system was used to measure barometric pressure, temperature, wind speed and direction.
apolidori, 1/28/2011
- a26** The MMS was set-up about 650 m west of the I-215 and approximately 450 m north of the I-10.
apolidori, 1/28/2011
- a47** apolidori 1/28/2011
As shown in Figure 2, the wind flow measured at the Colton station through the duration of study was primarily from the south-west, although a low speed north-east component was also present. The same wind pattern was observed during both February and March 2009 (not shown). These data demonstrate that the site in Colton was located downwind of the I-10 freeway for most of this field campaign.
apolidori, 1/28/2011
- A25** In the Winter/Spring of 2010, the atmospheric concentrations of particulate matter (PM10), ultrafine particles (UFP) and black carbon (BC) were measured at a proposed recreational park in Colton, CA to evaluate the extent to which motor-vehicle emissions from the nearby I-10 and the I-215 influence local air quality.
Andrea, 2/1/2011
- a24** Unlike PM10, UFP is currently not regulated by the U.S. EPA although recent studies have shown that exposure to this PM fraction is associated with the occurrence of both respiratory and cardiovascular problems.
apolidori, 1/28/2011

a58

AIT TOXICS MONITORING IN COLTON

a63

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- **Sampling location:** proposed recreational park

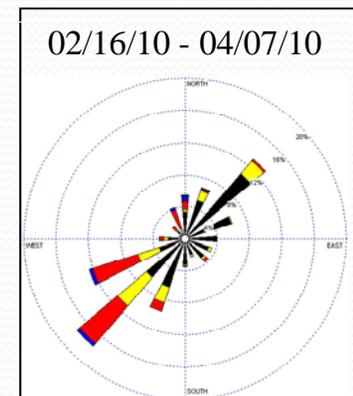
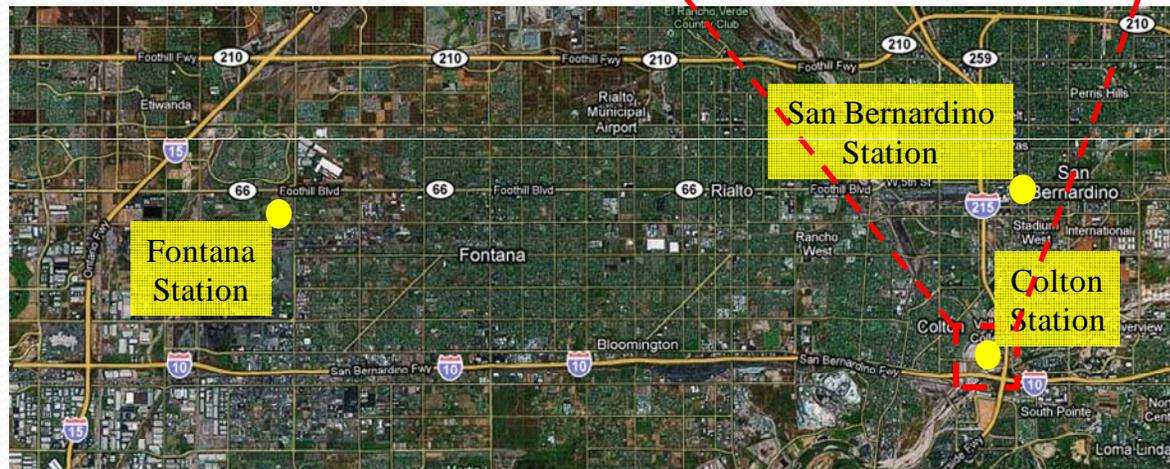
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a60

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a64



a65

WIND SPEED (mph)



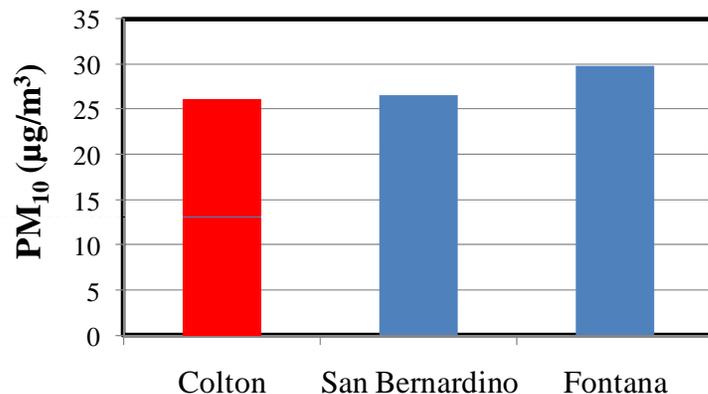
Slide 11

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apolidori, 1/28/2011
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apolidori, 1/28/2011
- a64** All air pollutant concentrations measured in Colton were then compared to those obtained at the permanent San Bernardino and Fontana air monitoring stations during the same time period. These are two of 36 permanent air monitoring sites operated by AQMD in the South Coast Basin and are located further away from the influence of both the I-10 and the I-215. The Fontana station is upwind of the temporary site in Colton and was intended to represent urban background concentrations for the study area.
apolidori, 1/28/2011

AIT TOXICS MONITORING IN COLTON: RESULTS

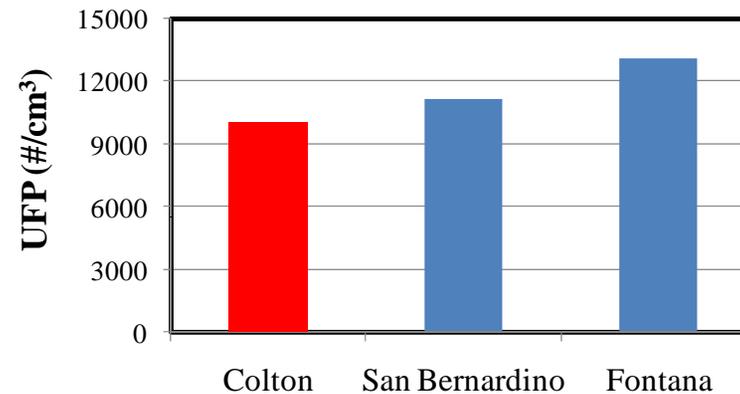
a36

COARSE PARTICLES



A27

ULTRAFINE PARTICLES



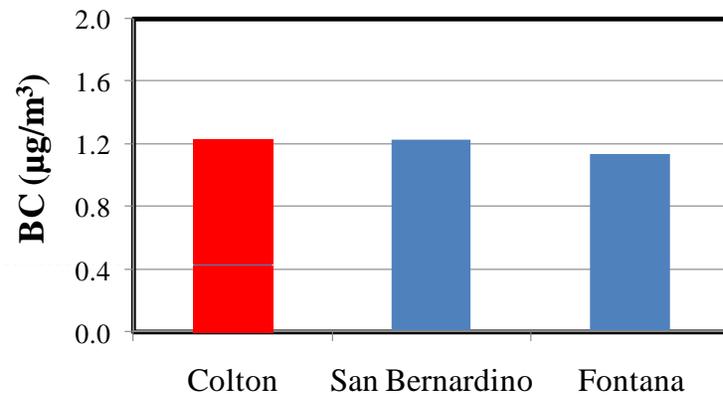
- PM₁₀ Colton < PM₁₀ San Bernardino < PM₁₀ Fontana (background) < PM₁₀ MATES III (37.0 µg/m³) <<< NAAQS (150 µg/m³)
- UFP Colton < UFP San Bernardino < UFP Fontana (background) < UFP South Coast Air Basin

Slide 12

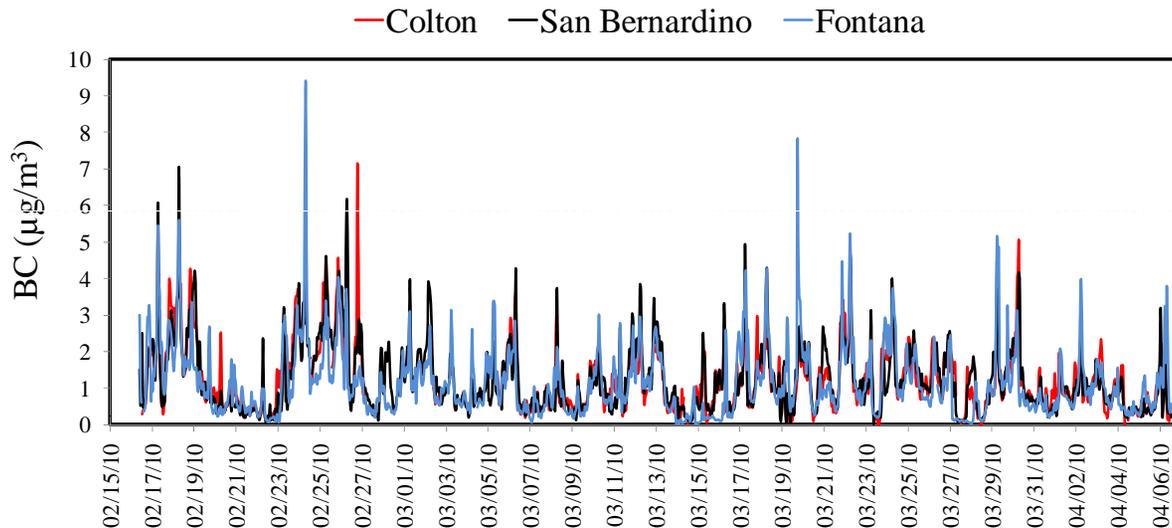
- a36** As shown in Table 1 and Figure 3, the study average PM10 levels at the Colton site and at the San Bernardino and Fontana stations were 25.8, 27.4 and 31.0 $\mu\text{g}/\text{m}^3$, respectively. The fact that the average PM10 concentration in Colton was lower than the corresponding levels in San Bernardino and Fontana (background) suggests that motor-vehicle emissions from the I-10 and I-215 freeways did not have a substantial impact on the atmospheric levels of this pollutant measured at the proposed park during the study period. These values are lower than the study average PM10 concentration observed in the South Coast Air Basin during the Multiple Air Toxics Exposure Study (MATES III; 2004-2006) (37.0 $\mu\text{g}/\text{m}^3$). None of the daily PM10 concentrations measured during the current field campaign was close to or higher than 150 $\mu\text{g}/\text{m}^3$, the present 24-hour National Ambient Air Quality Standard (NAAQS) for PM10.
apolidori, 1/28/2011
- A26** A comparison between measurements taken at the proposed park and at two permanent air monitoring stations located much further from freeways shows that the atmospheric levels of the measured pollutants were similar at all sites. This suggests that the proposed park location experiences pollution levels that are typical for the region and thus is not impacted by on-road sources any more than areas located further away from freeways. A follow-up study will be conducted in 2011 during different seasonal conditions.
Andrea, 2/1/2011
- A27** During this time period the average UFP number concentrations in Colton, San Bernardino, and Fontana were 9888, 11170, and 13069 $\#/\text{cm}^3$, respectively (Table 1). The average particle count level at the proposed recreational park was about 11 and 24% lower than the corresponding values observed in San Bernardino and Fontana (Figure 3). These ambient UFP levels are close to or lower than those observed at other urban sites of the South Coast Air Basin located away from the influence of a major freeway. Previous studies have shown that the concentration of most combustion-related pollutants emitted from motor-vehicles during daytime decreases exponentially downwind of a freeway and reaches background levels after 300-400 m. This data is consistent the previous studies given that the sampling location at the proposed park was more than 450 meters from both freeways
Andrea, 2/1/2011

AIT TOXICS MONITORING IN COLTON: RESULTS

BLACK CARBON



- BC Colton ~ BC South Coast Air Basin
- BC at all three sampling sites tracked each other well



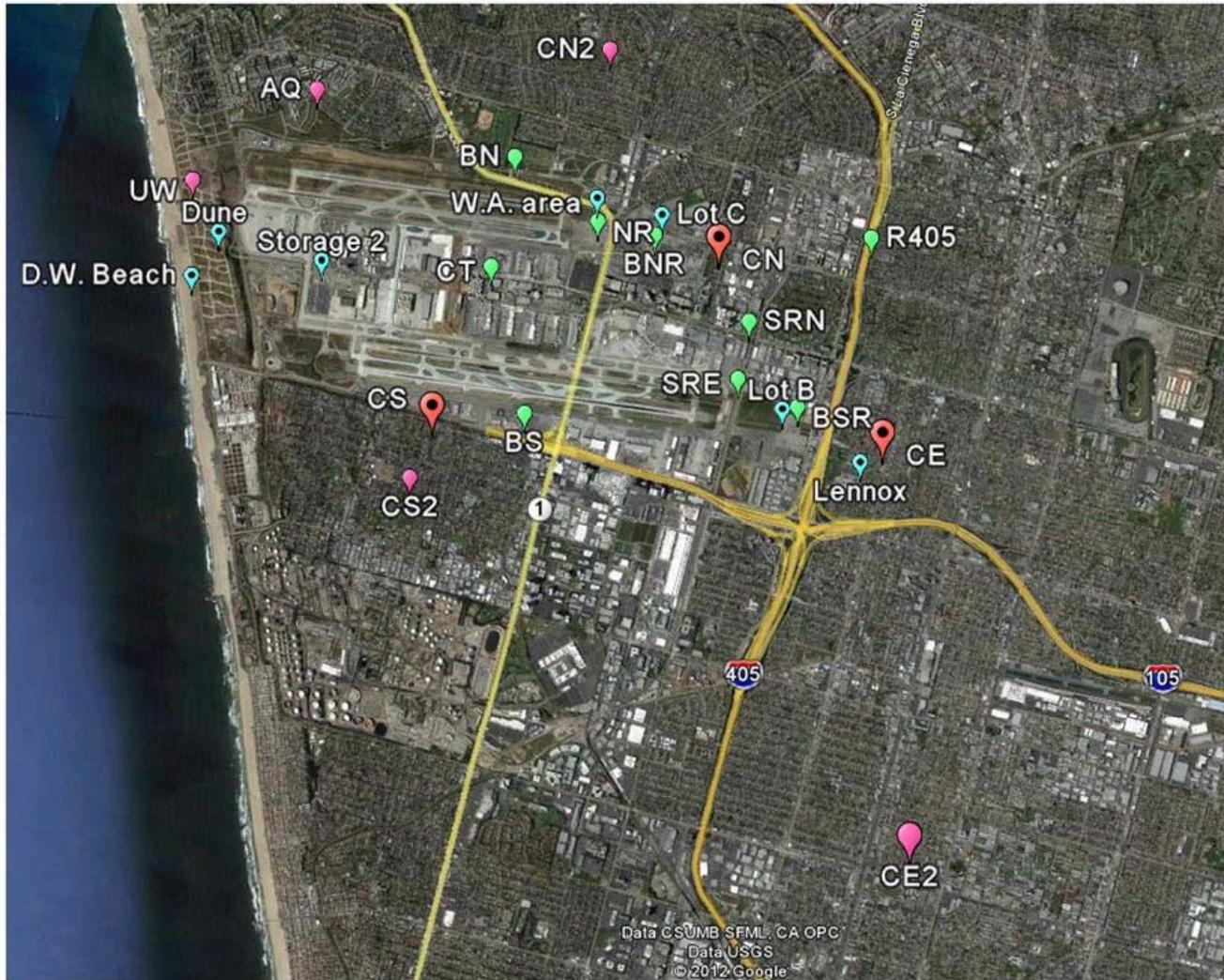
Slide 13

A28

The average BC concentration at the Colton site and at the San Bernardino and Fontana stations were 1.23, 1.23, and 1.13 #/cm³, respectively (Table 1). These BC levels are comparable to or lower than those observed in the South Coast Air Basin during previous monitoring studies. However, the 1-hour average BC concentrations at all three sampling locations tracked each other well (Figure 5) and, as was observed for PM₁₀ and UFP, our results indicate that motor-vehicle emissions from the I-10 and I-215 freeways did not have a substantial impact on the atmospheric BC levels measured at the proposed recreational park.

Andrea, 2/1/2011

CURRENT WORK: LAWA Study



 Satellite

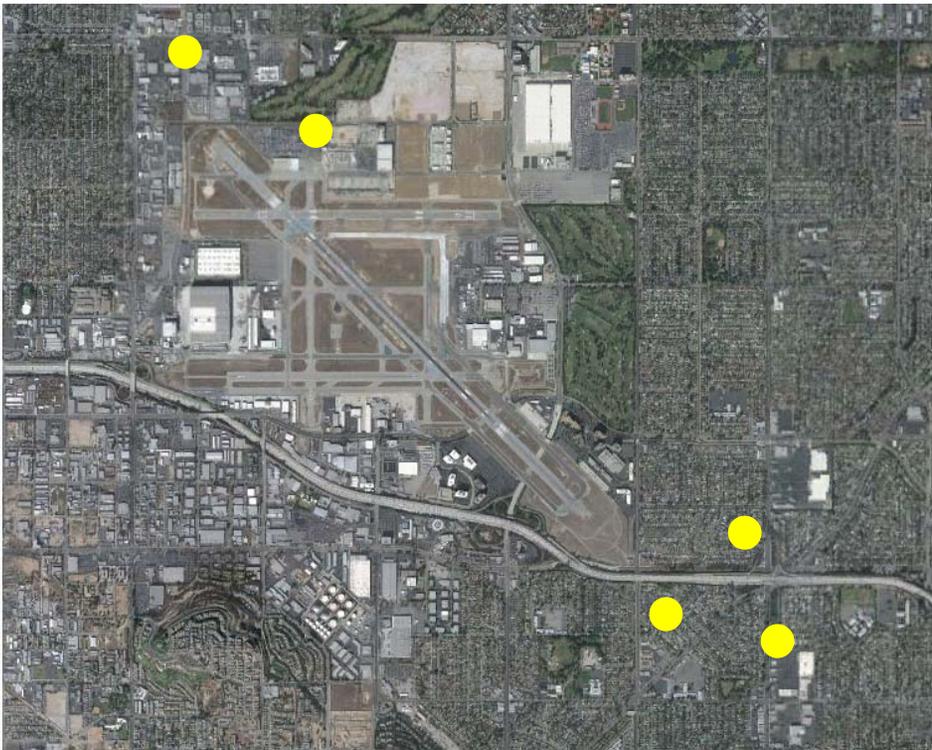
 Gradient

 AQMD trailer

 Gradient

FUTURE WORK: LGB Airport Study Plan

A15



A14

Objectives

- Air toxics levels in LGB communities
- Concentration gradients driven by proximity to LGB
- Area impacted by aircraft emissions and airport activities
- Freeway contributions
- Baseline data for longer term measurements

Part of EPA funded community-scale air monitoring grant

Slide 15

A14 These goals are consistent with the community-scale air monitoring goals of the EPA grant supporting the study.

Andrea, 2/1/2011

A15 Measurements will be conducted at different distances from the airport perimeter, both upwind and downwind of LGB. Pending permission from LGB authorities, measurements will also be taken in close proximity to the runways to better characterize aircraft emissions. Sampling at any given location will last from a few days to a week depending on aircraft traffic activity, meteorological conditions, and monitoring results

Andrea, 1/31/2011



SUMMARY

- Two MMS for fast response deployment in communities of the South Coast Air Basin were successfully developed
- One of the MMS was tested at a proposed recreational park in Colton. Measured air pollution levels were typical for the region
- The two MMS will soon be deployed at LGB and LAX

ACKNOWLEDGEMENTS

Richard Parent and the SCAQMD Special Monitoring group