Preliminary Results of the MAG PM_{10} Source Attribution and Deposition Study

Presentation to the Air Quality Technical Advisory Committee

Robert A. Baxter, CCM

January 11, 2007

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Overview

- Background
- Insights needed
- Revised scope of work
- Approach
- Monitoring tools
- Findings
- New control measures

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Background

Conclusions from the Salt River PM_{10} SIP Submitted to EPA in 2005

- Diurnal variation is dominated by morning & evening peaks with the former being greater than the latter (except at South Phoenix)
- Background was estimated to account for half of the measured concentrations
- Modeling provided limited insight into source contributions to monitored concentrations
- Model performance on high-wind days was superior to low-wind days

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Background

Evaluations of Salt River PM_{10} Violations Recorded in Winter 2005

- Low wind speed conditions
- Multi-day episode
- Peak values recorded in the morning
- Morning drainage flow from east not evident
- Apparent correlation with morning traffic
- High concentrations recorded at both West 43rd and Durango

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Insights Needed

- Determine principal cause of modeling shortfall
  - Representativeness of local inventory
  - External source representation/transport
- Determine if local sources are poorly characterized
  - Magnitude
  - Diurnal activity

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Insights Needed

- Determine significance of external sources/transport under stagnant conditions
  - Confirm lack of eastern drainage
  - Determine direction of morning transport
  - Assess possible sources
- Assess local source significance for
  - West 43rd Avenue
  - Durango Complex

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Revised Scope of Work
(key questions to be addressed)

- Where are the specific source areas and/or sources in the Salt River region that contribute to the PM loading at the Durango Complex and West 43rd monitoring sites?

- To obtain useful results from models such as AERMOD, can the regional particle size distribution be characterized on an area basis (i.e., is there an area of uniformity that can be generalized?)

- What are the causes of heavy PM loading during the morning hours at the Durango and West 43rd monitors? Are the diurnal variations of PM_{10} and peaks due to reentrainment of paved road dust, or due to other activities in the surrounding areas that are coincident with traffic peaks?

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Approach

Assess existing meteorological and PM data

- Evaluate exceedance day conditions
- Focus on Durango and West 43rd monitoring sites
- Determine key wind directions and potential sources
- Identify key time periods for detailed sampling
- Daily coordination with MAG

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Approach

Select monitoring tools

- Particle lidar
- Mobile monitoring
- DustTrak optical PM_{10}
- DustTrak optical $PM_{2.5}$
- Aerodynamic particle size analyzer
- MiniVol filter based sampler
- Sodar
- SCAMPER

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Approach

Establish sampling plan

- Define routes for mobile sampling
  - Map distribution of PM levels
  - Identify areas of interest
  - Characterize diurnal variations in PM levels
  - Characterize size distribution of PM
- Determine location of meteorological data collection
- Select locations to investigate dispersion of roadway sources
- Conduct sampling in two phases
- Coordinate with local agencies for related data
- Perform daily review of collected data to identify insights, opportunities and problems.

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Monitoring Tools

- Particle lidar
- Mobile monitoring
- DustTrak optical PM_{10}
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- MiniVol filter based
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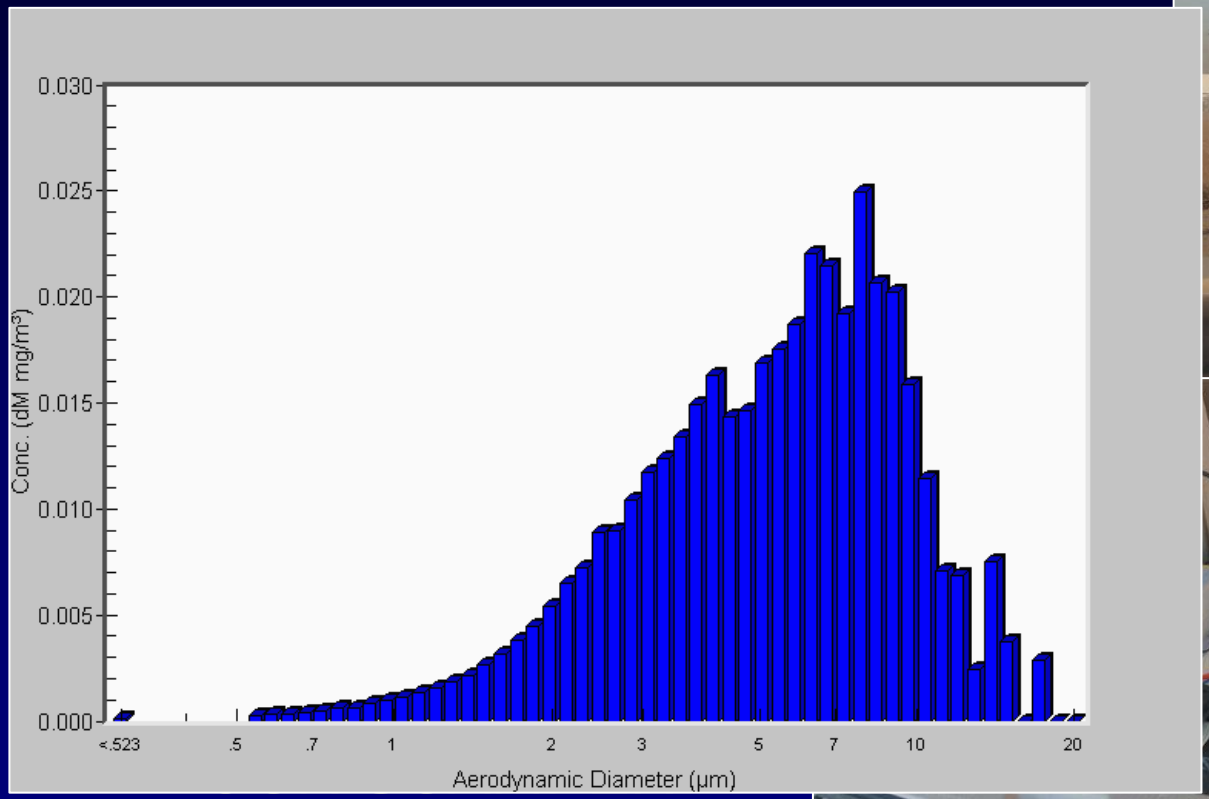
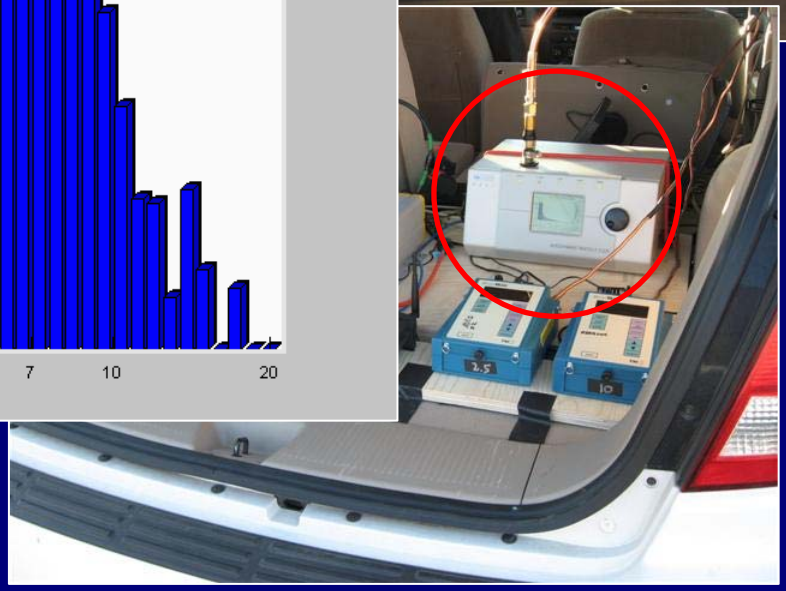
Monitoring Tools





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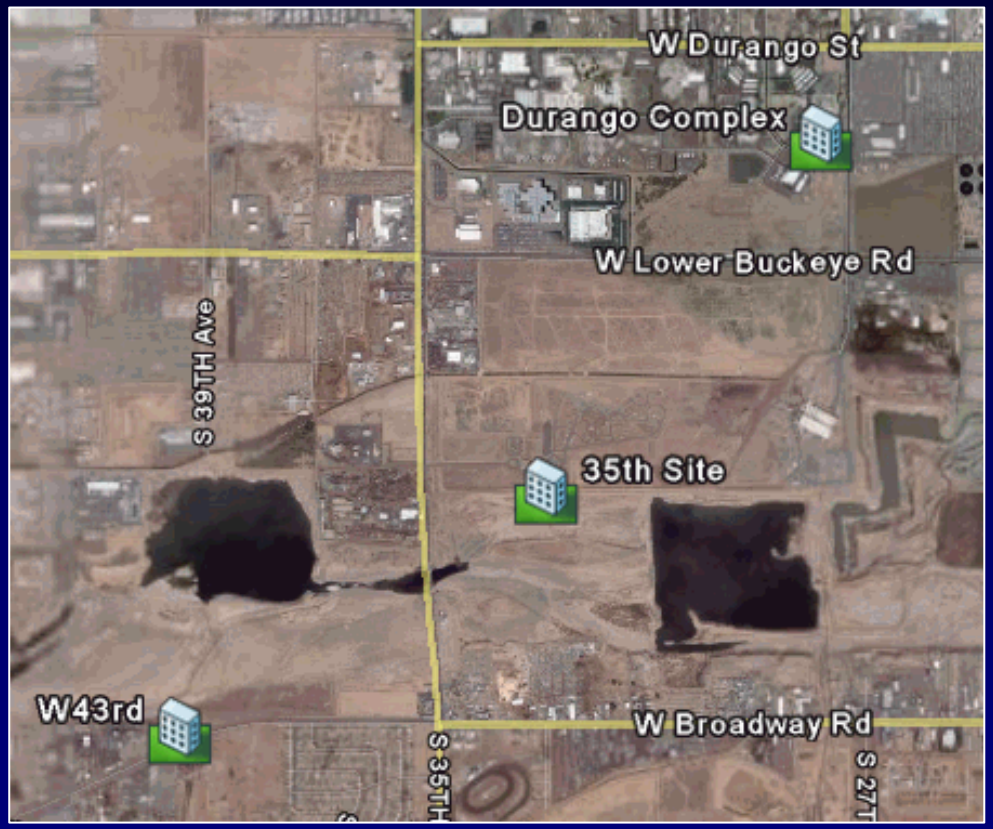

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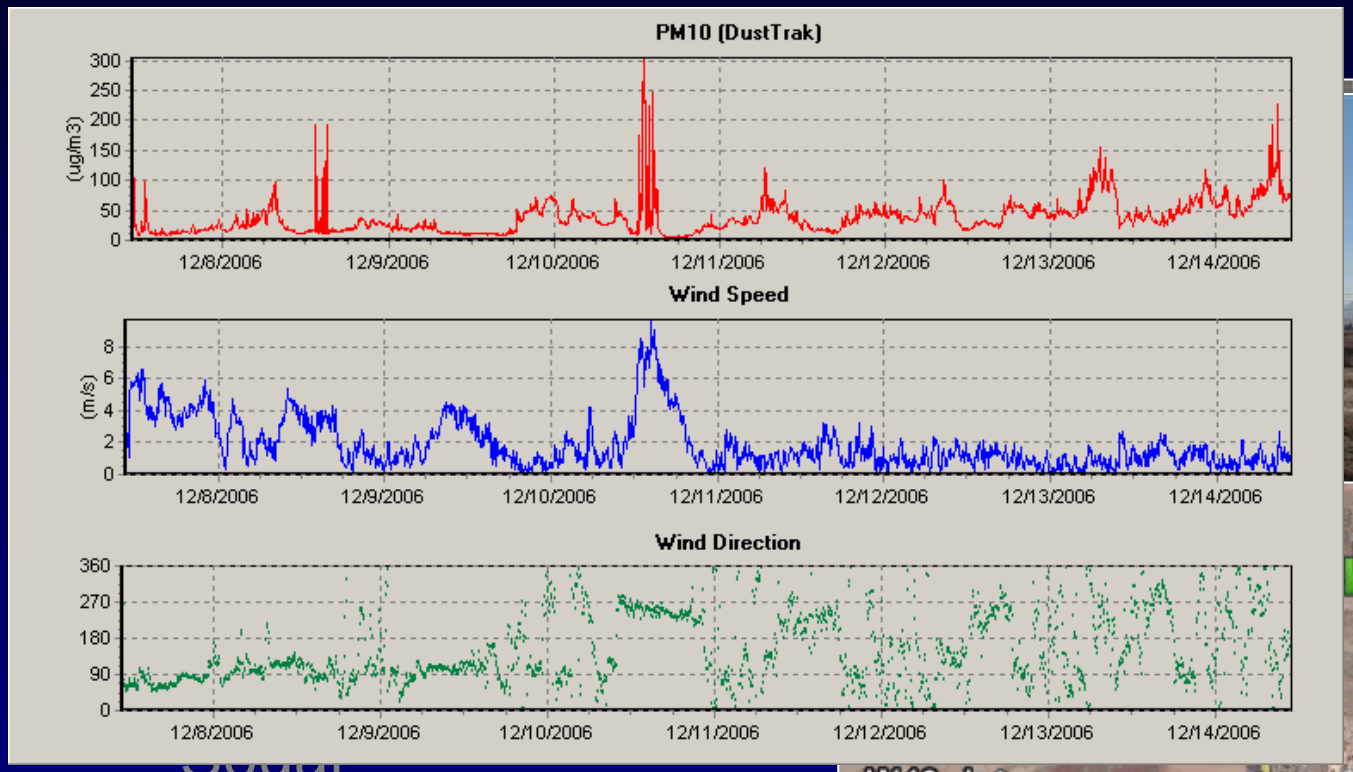

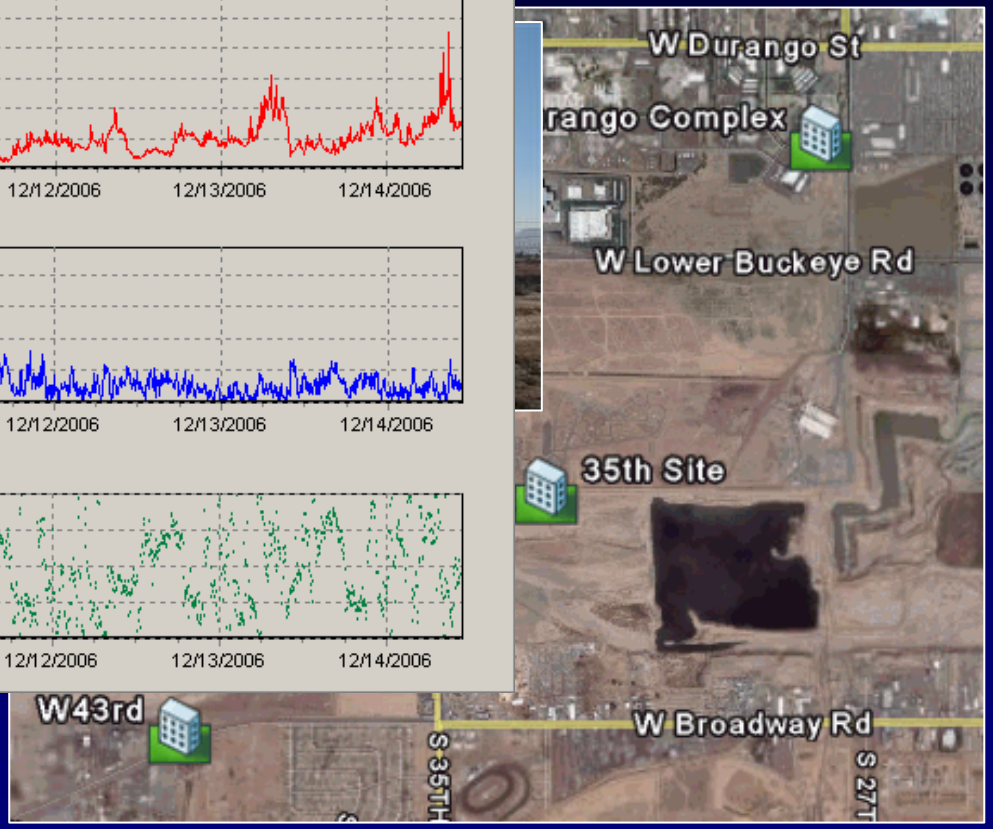

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Application of Monitoring Tools

- Map the distribution of particulate matter and identify regions of interest
  - Mobile van
  - ASU lidar
- Characterize the diurnal variations in PM levels
  - 35th Avenue site operated 24 hours/day
- Characterize the size distribution of PM
  - Particle size analyzer operated from the mobile van
  - DustTraks operated from the mobile van and at fixed sites
  - Permanent PM monitors operated by MCAQD
- Characterize the meteorology during stagnation events
  - Vertical wind profile and mixing height from MiniSodar
  - Wind velocity distribution from lidar
  - Wind measurements from the mobile van and MCAQD sites

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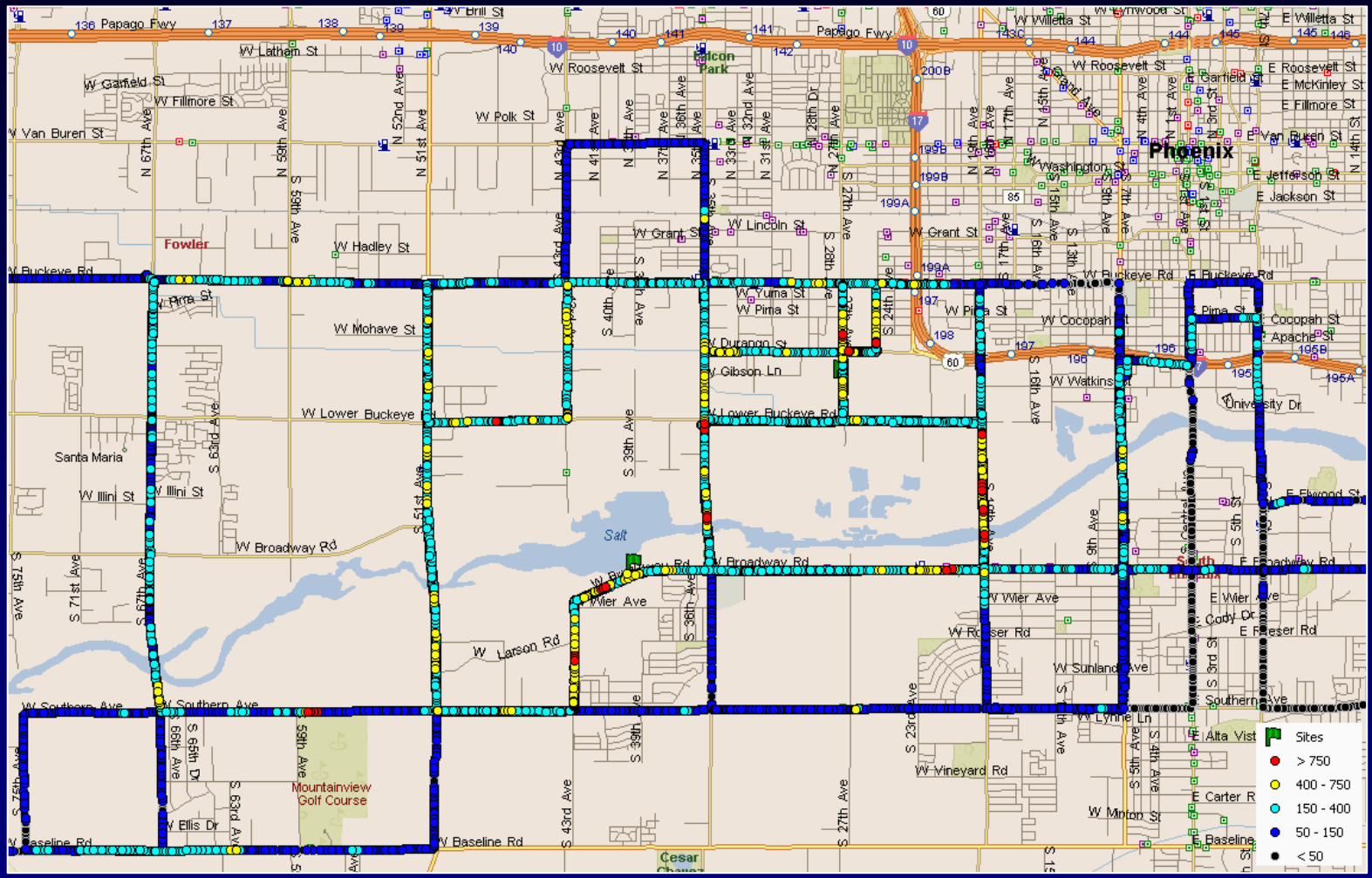
Example Mobile Van Mapping

November 15 0400 to 1000



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Conceptual Model of the Problem

- Winter versus summer
  - Later sunrise
  - Stagnant atmosphere
  - Peak potential emissions
- Traffic schedule during morning stagnant conditions
  - High volume hauling traffic
  - Peak commuting traffic
- Drainage through the Salt River Basin
  - Apparent disconnect of the surface layer (e.g. lowest 50 meters) from potential drainage aloft
- Wide variety of significant local sources
- Carryover from prior days (stagnation)

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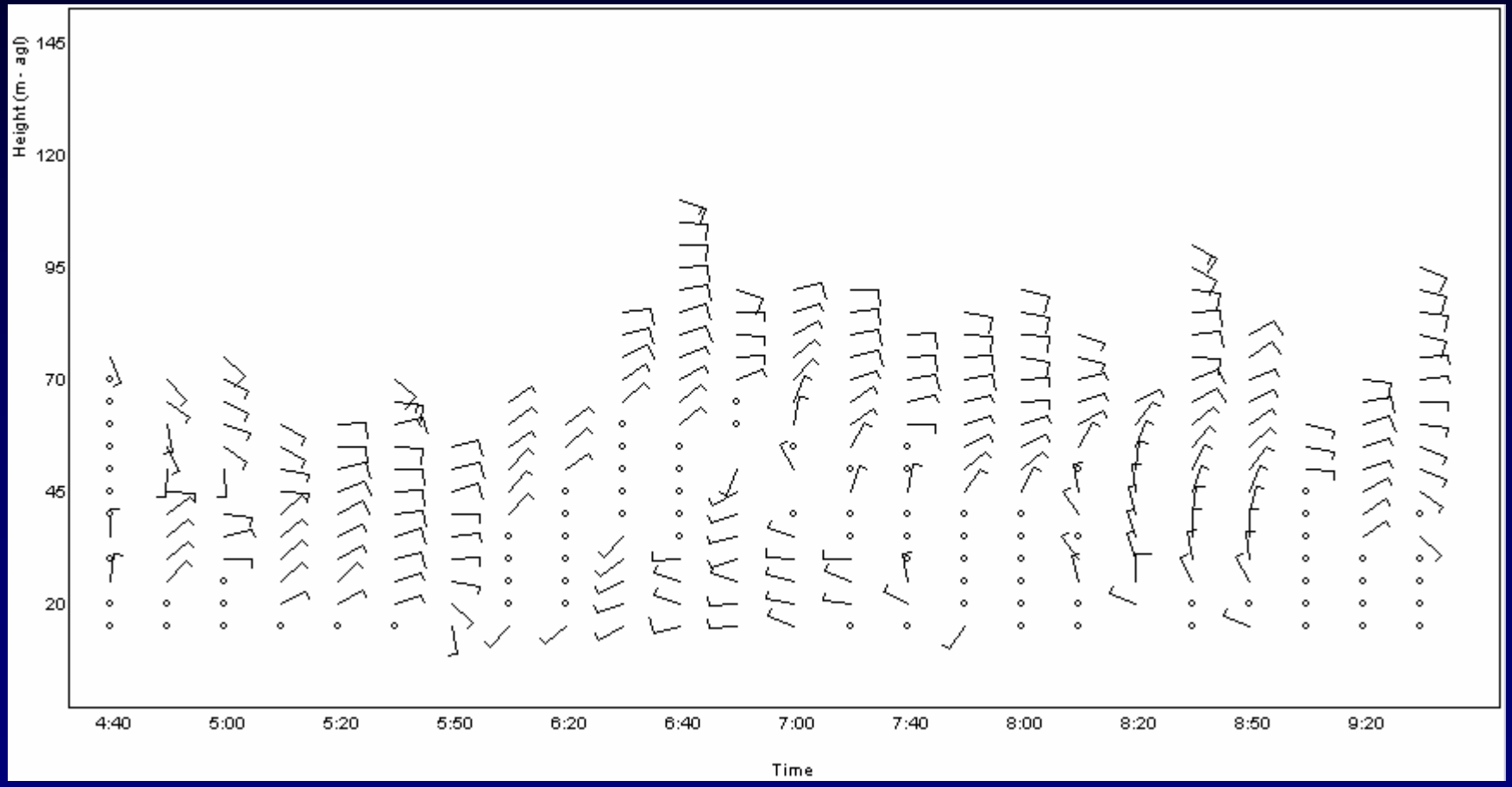
Conceptual Model of the Problem

Sodar data from W43rd



December 6, 2006

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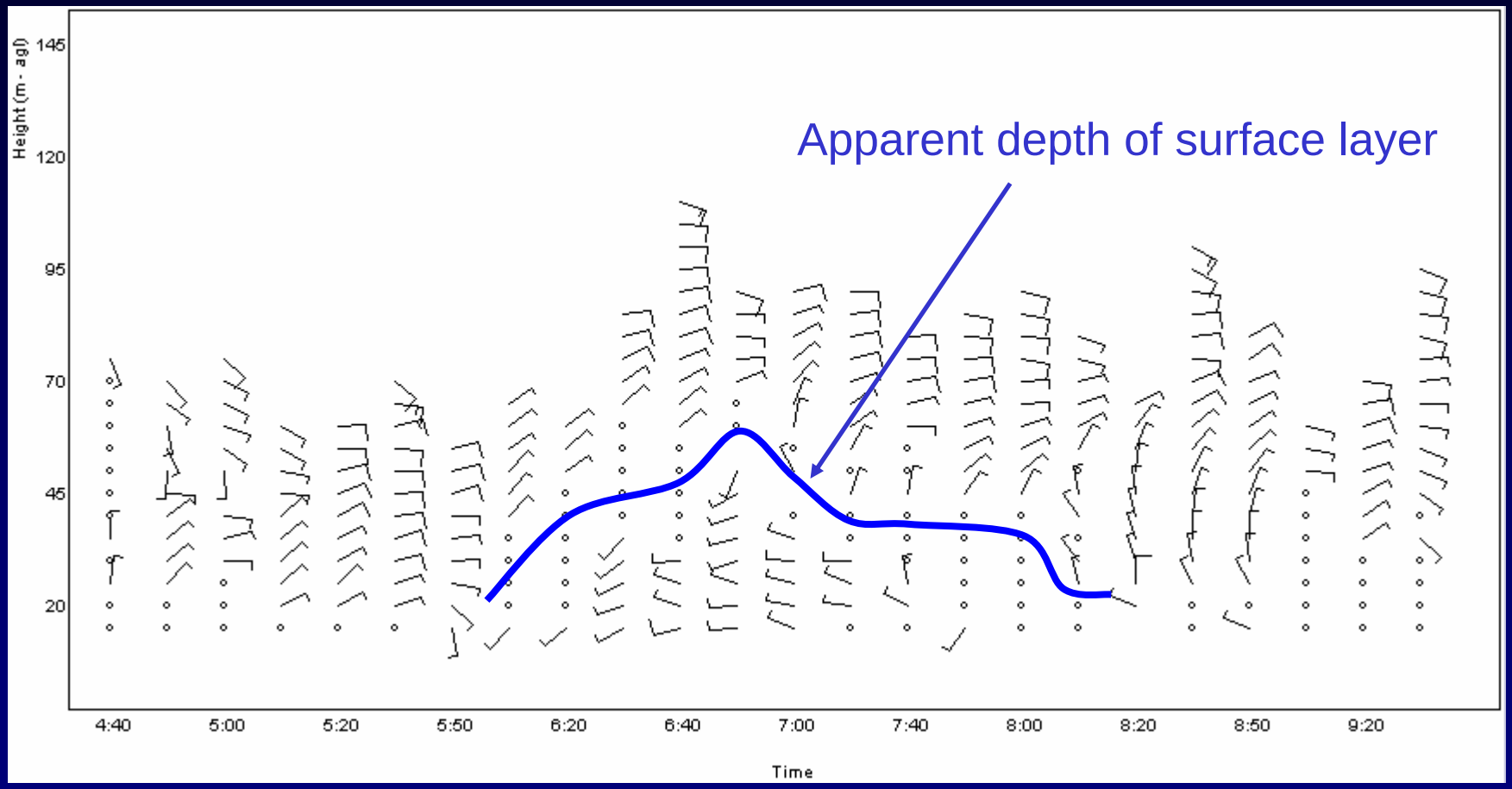
Sodar data from W43rd



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Field Observations

- Field sampling in two phases
  - November 13 – 19
  - November 28 – December 14
  - Weekday and weekend sampling
- Observed exceedances at monitors based on preliminary data
  - West 43rd on 11/16, 11/17, 11/27*, 12/5, 12/6, 12/7, 12/14
  - Durango Complex on 12/6 and 12/7

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Field Observations

- Detailed sampling on 17 days
  - Boundary conditions
  - North/South traverses
  - East/West traverses
  - Particle size distribution for source characterization
  - Gradients away from primary roads
  - Gradients across the Salt River

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Field Observations

- Detailed sampling on 17 days
  - Characterize the sources around the monitors
  - Intercomparisons with site monitors
  - Upwind/downwind monitoring
  - Search for plumes and potential sources
  - Major identified sources
  - Tracking large plumes
  - Visual documentation

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PM Source Examples

- Trackout
- “Dragout” from unpaved or poorly maintained paved roads or parking lots
- Unpaved shoulders
- Unpaved roads
- Open burning
- Agriculture
- Vehicle activity on parking lots

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Trackout

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Trackout

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Trackout

Dragout

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Dragout

Unpaved Shoulders

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Unpaved Shoulders

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Unpaved Shoulders

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Unpaved Roads and Dragout

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Unpaved Roads Dragout and Unpaved Shoulders

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Open Burning

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Open Burning and West 43rd PM_{10}

December 7, 2006

Time	Wind Speed (mph)	Wind Direction	PM_{10} ($\mu g/m^3$)
0400	1.2	S	102
0500	1.0	N	208
0600	0.8	ENE	381
0700	0.4	**SSW**	**515**
0800	0.7	**WSW**	**566**
0900	2.3	W	284
1000	3.0	W	240
1100	6.6	ENE	111

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Open Burning and West 43rd PM_{10}

December 7, 2006

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Unpaved Lots

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Vehicle Activity on Unpaved Lots

Saturday November 18, 2006

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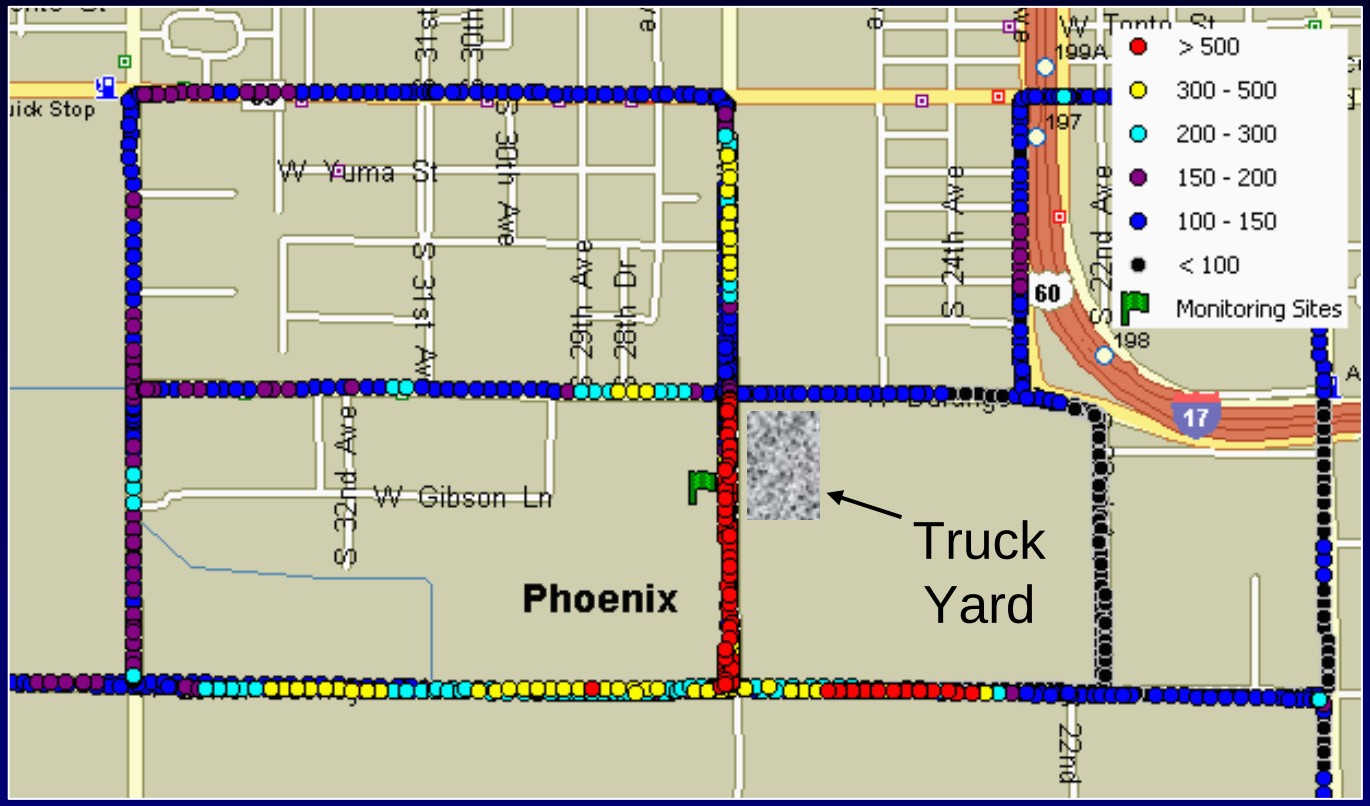
Vehicle Activity on Unpaved Lots

Sunday November 19, 2006



PM_{10} Data Points 08:00 – 08:35

07:00 Wind North at 0.6 mph PM_{10} – 151 $\mu g/m^3$

08:00 Wind East at 0.8 mph PM_{10} – 361 $\mu g/m^3$

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Vehicle Activity on Unpaved Lots

Sunday November 19, 2006

08:00 Wind East at 0.8 mph PM_{10} – 361 $\mu g/m^3$

Control Measures to be Investigated

- Establish continuous monitoring requirements for construction projects and permitted facilities larger than 50 acres
  - Investigate the use of continuous PM measurements at boundaries
  - Consider elimination of opacity and silt requirements in exchange for continuous monitoring
  - Assess cost effectiveness

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Control Measures to be Investigated

- County purchase and operate mobile monitoring system to measure site specific values and issue NOVs
  - Investigate use of continuous PM measurements to measure silt levels and/or ambient concentrations
  - Configure to collect measurements on public and private paved surfaces (i.e., both roads and parking lots)
  - Assess cost effectiveness

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Control Measures to be Investigated

- Cessation of activities during stagnant conditions
  - Review historical data to determine frequency of occurrence
  - Establish criteria/thresholds governing implementation
  - Consider operations to be affected
  - Consider benefits of voluntary and mandatory compliance
  - Assess cost effectiveness

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Control Measures to be Investigated

- Modify Rules 310 and 310.01
  - Establish maintenance requirements for paved roads and parking lots (e.g., silt levels, opacity limits, etc.)
  - Establish control requirements for “dragout” emissions (assess whether “carry-out” provisions of Rule 310 provide adequate control)
  - Consider property line restriction (i.e., no visible emissions) in place of opacity limit

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Control Measures to be Investigated

- Expanded enforcement
  - Nighttime inspection
  - Increased facility inspection
  - Increased staffing
  - Increased use of technology

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