Air Monitoring Study at the Santa Monica Airport

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Santa Monica Airport (SMO)

- Surrounded by a large residential community

- ~3000 operations per day (2009)

- ~14,000 annual jet air traffic (2009)

- Total aircraft operations: 111,688 (2009)
    - 85% Propellers
    - 13% Jets
    - 2% Helicopters

- No buffer zone separating SMO from adjacent neighborhoods

- Concerns about possible health effects from exposure to airport related emissions

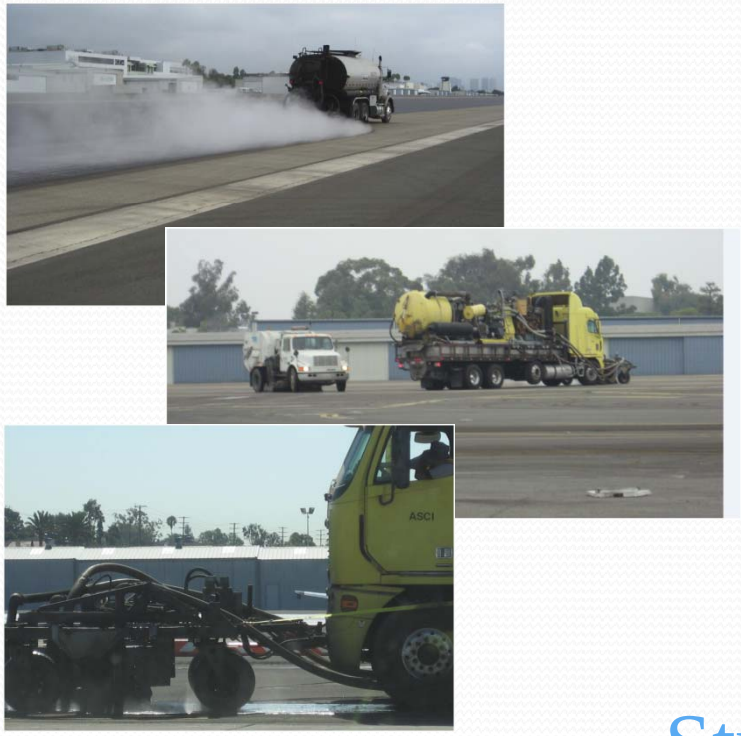
AQMD's "General Aviation Study" (April 2006 - March 2007)

- U.S. EPA "Community-Scale Air Toxics Grant"
- <u>Long-term</u> impact of aircraft emissions/airport activities on communities surrounding SMO
- TSP Lead and UFP concentrations substantially higher than background
- Sharp 1-min UFP peaks downwind of the runway

50 m

Repaving Project at SMO

- "Pavement Rehabilitation Project": September - October 2010
- Paving improvements in and around the runway area



Phase I – Airport Closures
09/14/2010 8:00 pm – 09/15/2010 6:00 am
09/15/2010 8:00 pm – 09/16/2010 6:00 am
09/16/2010 8:00 pm – 09/17/2010 6:00 am
09/17/2010 8:00 pm – 09/18/2010 6:00 am
09/18/2010 8:00 pm – 09/19/2010 6:00 am

Only closed at night

Phase II – Airport Closures
09/19/2010 8:00 pm – 09/24/2010 6:00 am

Full closure

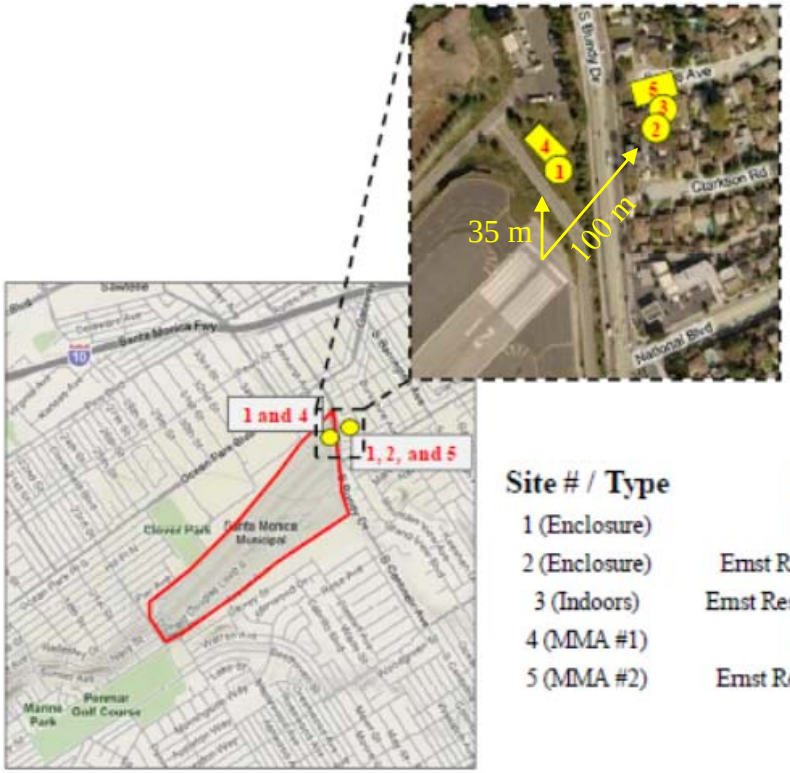
Phase III – Taxiway & Infield Area Closures
09/25/2010 – 10/5/2010 (airport will remain open)

Airport re-opened

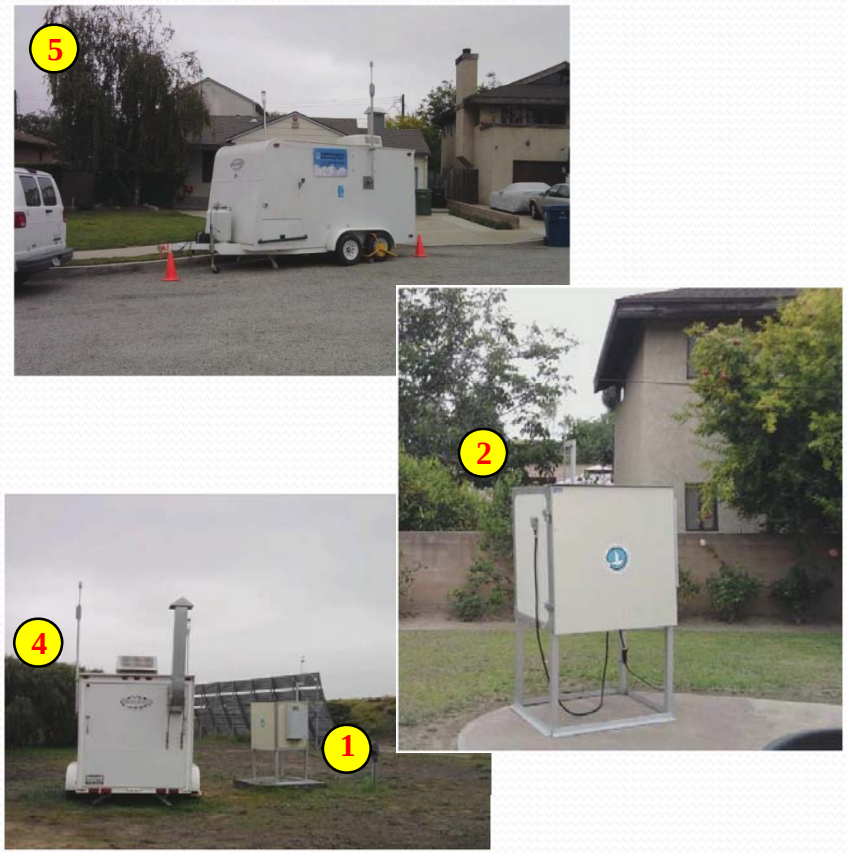
Study Objectives

- Measure air toxics levels <u>with and without</u> aircraft activity
- Characterize <u>short-term</u> airport impacts on nearby communities

Methods

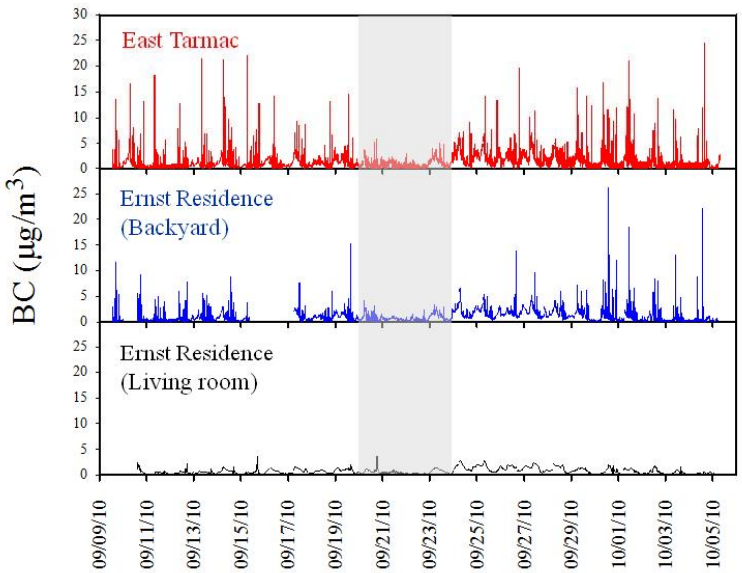


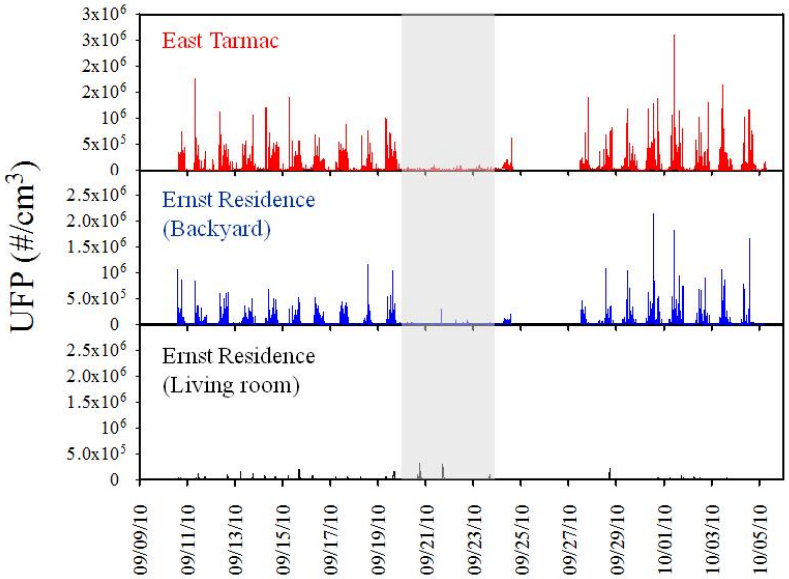
Site # / Type	Location
1 (Enclosure)	East Tarmac
2 (Enclosure)	Ernst Residence (Backyard)
3 (Indoors)	Ernst Residence (Living-room)
4 (MMA #1)	East Tarmac
5 (MMA #2)	Ernst Residence (Front yard)



- East Tarmac site: close to the blast-fence
- Ernst Residence site (Backyard): under fixed wing arrival/departure route; lower elevation than SMO
- Ernst Residence site (Living-room): away from potential indoor PM sources
- **UFP**: water-based CPC (TSI 3785; up to 10,000,000 #/cm^3); **BC**: Aethalometer (Magee Scientific AE42)
- **VOCs**: NMHC (Mocon 9000) + Multi-canister sampling system (Xontech 912) + GC/MS (or FID) (TO-15)
- **Meteo** data: WS, WD, T, and RH
- **Aircraft info**: type (i.e. jet or turbo-prop), model, and weight + taxi, hold and departure times

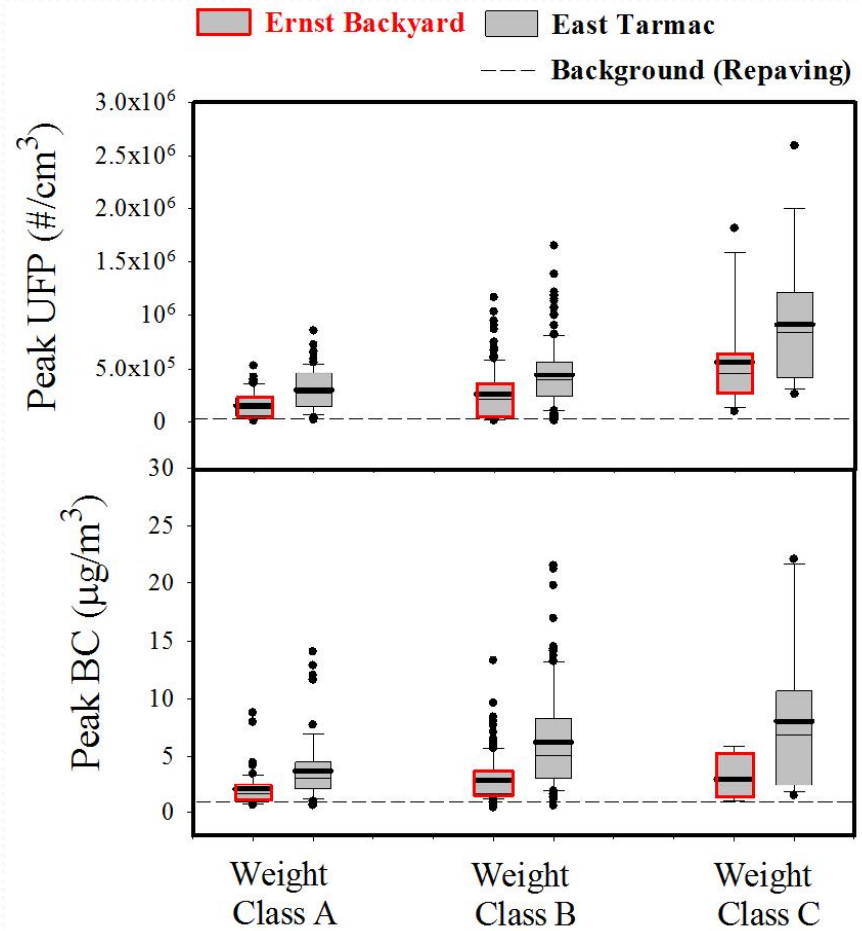
Results – UFP and BC Variations

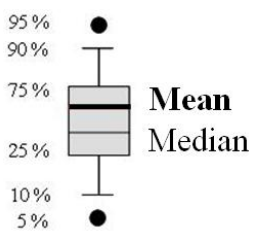




- Sharp peaks caused by aircraft emissions
- Highest concentrations typically measured at the East Tarmac site
- Potential contributions from nearby surface traffic at the Ernst Residence site
- The majority of combustion-related particles did not infiltrate indoors (doors/windows were kept closed)
- Substantial decrease in UFP and BC levels due to suspension of all airport activities (grey area)

Results – Effect of Aircraft Weight





ETMS Data Services guidelines

Weight Class A: < 12,500 lb
Weight Class B: 12,500 – 41,000 lb
Weight Class C: > 41000 lb

80% of all departing aircraft

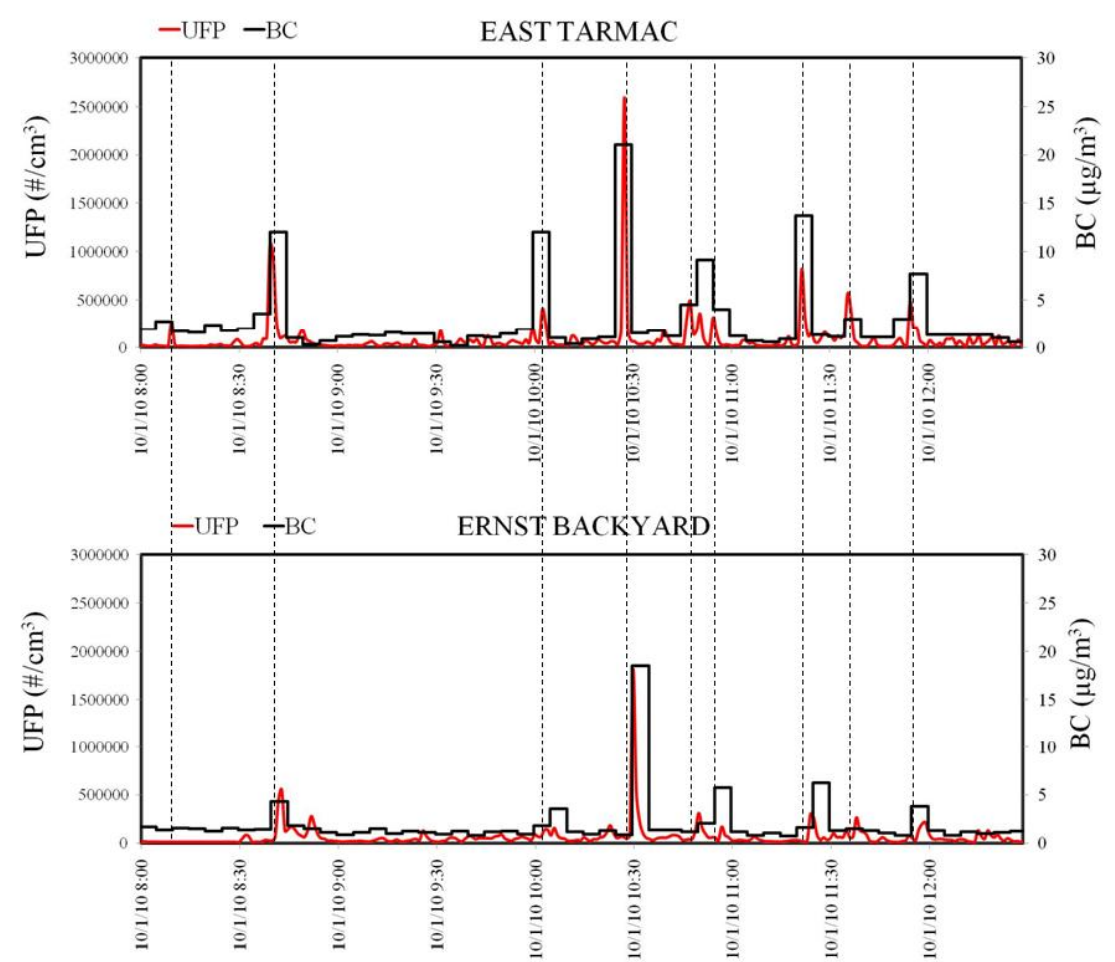
- Heavier aircraft emit higher amounts of UFP and BC
- Aircraft weight has a substantial impact on BC and (especially) UFP
- Average UFP peak concentrations at East Tarmac (& Ernst Backyard):

Weight Class C: Background	72 (& 50)
Weight Class B: Background	35 (& 23)
Weight Class A: Background	24 (&13)

- Average BC peak concentrations at East Tarmac (& Ernst Backyard):

Weight Class C: Background	7.6 (& 3.3)
Weight Class B: Background	5.9 (& 3.2)
Weight Class A: Background	3.5 (& 2.2)

Results – Effect of Aircraft Activity

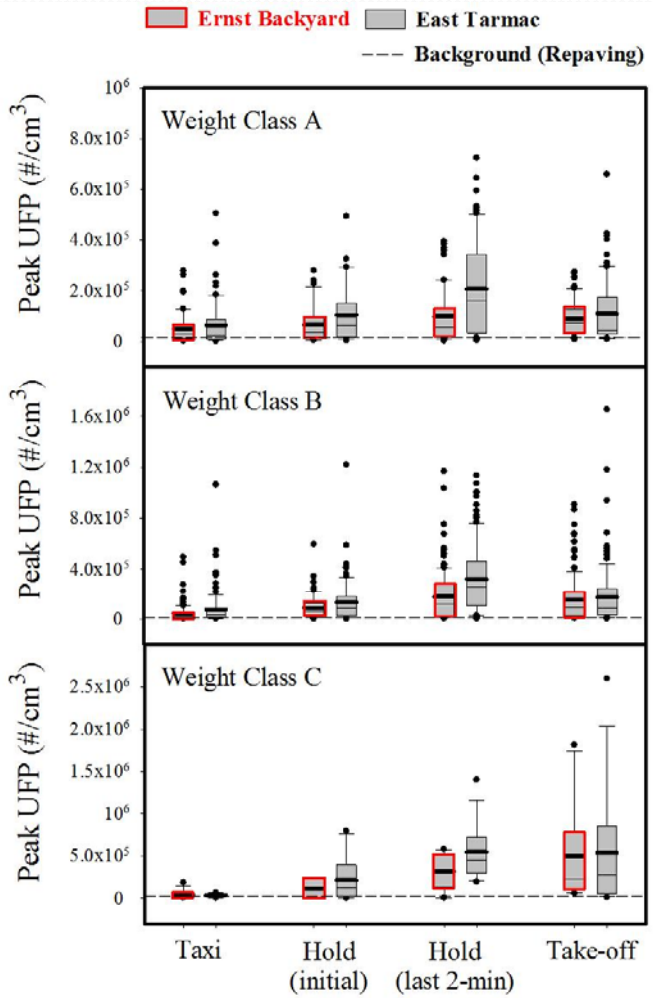


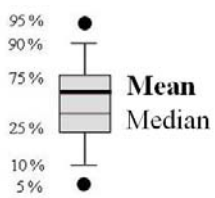
Summary Statistics of Traffic Activity Data From 09/12/10 to 10/03/10

	Taxi	Hold	Grand Total (Taxi + Hold)
Average	0:02:42	0:04:14	0:06:56
Median	0:02:32	0:02:57	0:05:43
5th %	0:01:22	0:00:25	0:02:28
95th %	0:04:21	0:12:43	0:15:31
Min	0:00:00	0:00:08	0:01:13
Max	0:18:21	0:44:05	0:45:51
Stdev	0:01:24	0:04:31	0:04:46
Valid N	372	372	372

- UFP and BC peaked when aircraft was taking-off (broken lines) or holding on the runway right before departure

Results – Effect of Aircraft Activity



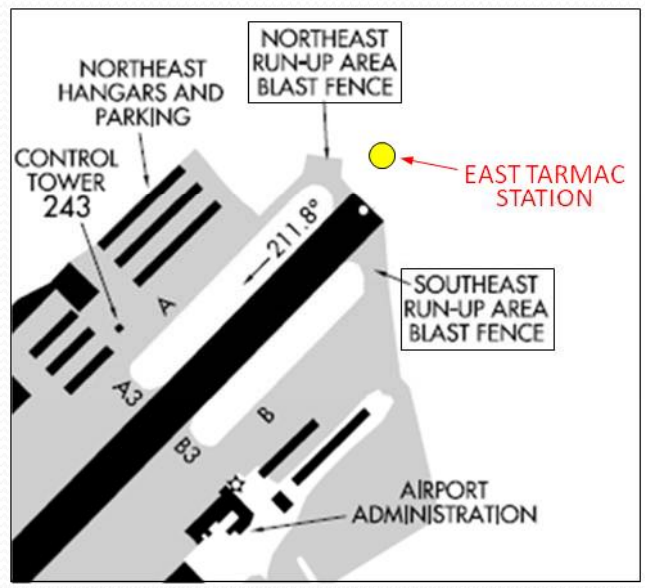


ETMS Data Services guidelines

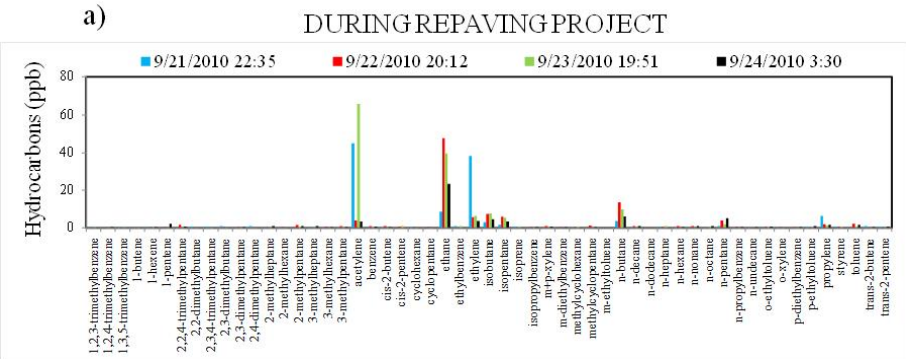
Weight Class A: < 12,500 lb
Weight Class B: 12,500 – 41,000 lb
Weight Class C: > 41000 lb

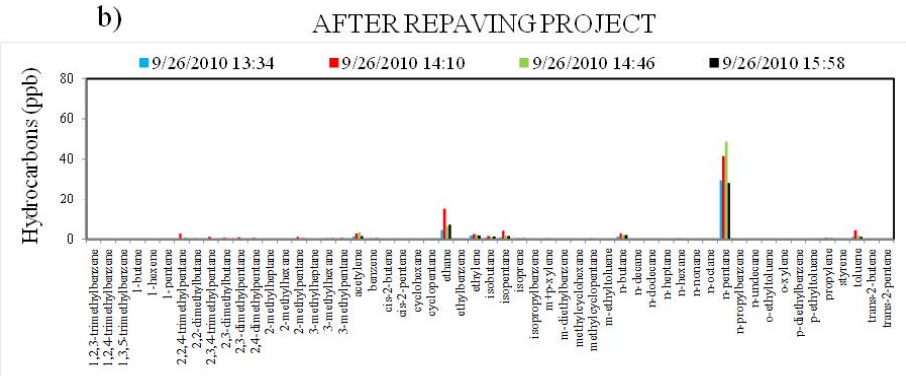
- Taxi: aircraft waiting near runway
- Hold "initial": up to two minutes before departure
- Hold "last 2-min": last two minutes of holding time. Aircraft moves from holding area to point of departure. Pre-flight run-ups
- Take-off

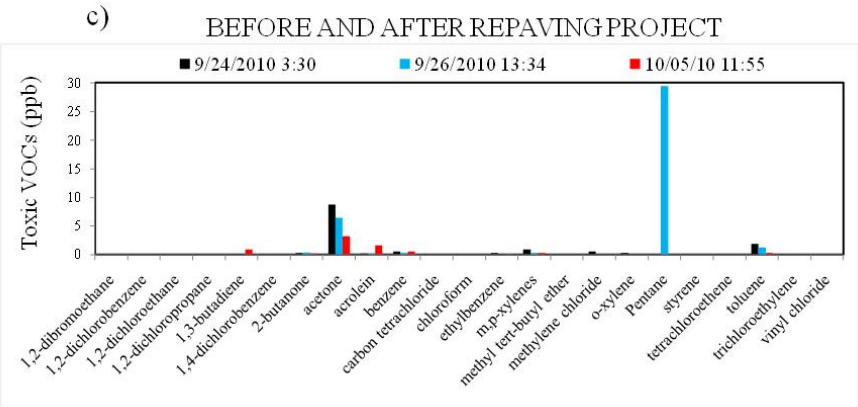
- Highest UFP peaks observed within the last two minutes of the holding period (Weight Classes A and B) and during take-off (Weight Class C)



Results – VOCs (East Tarmac Site)







- Nine canister samples collected and analyzed for more than 60 VOCs
- Enhanced acetylene, ethane, and ethylene levels (non toxics chemicals) during repaving. Increased motor-vehicle traffic on runway
- Unusually high levels of pentane (non toxic chemical) after re-opening of SMO. Solvents stored near the East Tarmac site
- Concentrations of all other VOCs were typical of the South Coast Air Basin

Summary and Conclusions

- Airport impacts on UFP and BC levels are substantial on short time scales (e.g. 1 to 5-min), but less significant when long-term averages (e.g. days to months) are considered

- Sharp short-term peaks in UFP and BC concentrations emitted by jet aircraft right before and during take-off

- Health effect studies are needed to better characterize short-term risk due to exposure to these and other aircraft/airport related emissions

- Potential mitigation measures:

    - Increasing width of the blast fence
    - Reducing holding times for all jet aircraft
    - Re-directing the exhaust from pre-flight run-up tests
    - Limiting traffic for “large commuter” (>41,000 lb) aircraft