Final Results from EPA's Lead Modeling Study at the Santa Monica Airport

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Goals and Objectives

- The goal of this study was to develop an approach to model ambient air lead concentrations near airports.
- Lead emissions from piston-engine aircraft and leaded aviation gasoline are Federally-regulated.
- EPA received a petition to determine whether lead emissions from piston-engine aircraft endanger human health and the environment.
- The results of this study are being used to inform an EPA national-scale analysis of the local impact of lead emissions from piston-engine aircraft.

Primary Purpose of the Study

- To develop a modeling approach to quantify how emissions from piston-engine aircraft affect ambient lead levels at the local scale
- The new approach allows EPA's air quality model, AERMOD, to be used to:
  - More realistically model landing and take-off (LTO) emissions
  - More realistically model ground-based aircraft activity & emissions
  - Account for affects of aircraft-induced turbulence on the dispersion of aircraft emissions

Secondary Purpose of the Study

- Monitor air, soil and dust lead concentrations in order to:
  - Evaluate AERMOD results
  - Explore the potential for intrusion of avgas lead to indoor spaces
  - Explore the potential impact of leaded avgas use on soil lead concentrations

Why We Chose Santa Monica Airport

- South Coast Air Quality Management District (SCAQMD) conducted a study at Santa Monica Airport in 2006.
  - Monitored lead at 7 sites for two 3-month periods
- Santa Monica Airport has excellent data collection regarding activity of piston-engine aircraft.
- There are no major point sources of lead within 1 mile of the airport.
  - This made it simpler to do the model development work that was the focus of this project
- Santa Monica was the 105th busiest general aviation airport in the country in 2005.
- Santa Monica Airport has a dense nearby population.
  - 6,500 people live within 0.5 km of the airport.

Leaded Avgas is Used Only in Piston-engine Aircraft

- Santa Monica Airport supplied daily aircraft operations
- We collected data at the airport to use in our model:
  - Single- versus twin-engine piston-powered aircraft operations
  - Time spent by piston aircraft during operation modes: taxi, idle, run-up check, take-off and landing
  - Two avgas samples
- Meteorological data was obtained from the National Climatic Data Center for the sonic anemometer operating at the airport

Overview of the Study

- Collected model input data
  - Detailed lead inventory for all sources within 25 Km of the airport
- Collected air, soil and dust samples
- Conducted model-to-monitor comparison
- Modeled ambient lead concentrations for every day of 2008
  - Calculated 3-month average lead concentrations for comparison to the Lead NAAQS
  - Identified the maximum average 3-month concentrations
  - Conducted sensitivity analysis

Air Monitoring
-results (ng/m3) for the days used in the winter and summer model-to-monitor comparisons

N/A: not collected bdl: is below the detection limit

Soil and Dust Sampling

- We collected soil and dust samples on airport property, in local parks, and at local residences.
  - Results showed no elevated lead on airport property or in local parks, compared to average, non-source impacted levels in California.
  - Two home samples had lead levels above either the EPA or Draft CAL/EPA lead screening levels
- Aviation lead may have contributed to these levels, but the results suggest additional sources may be involved.

Soil and Dust Lead Concentrations

Soil and Dust Sample Results, continued

Air Modeling: Monitor-to-Model Comparisons

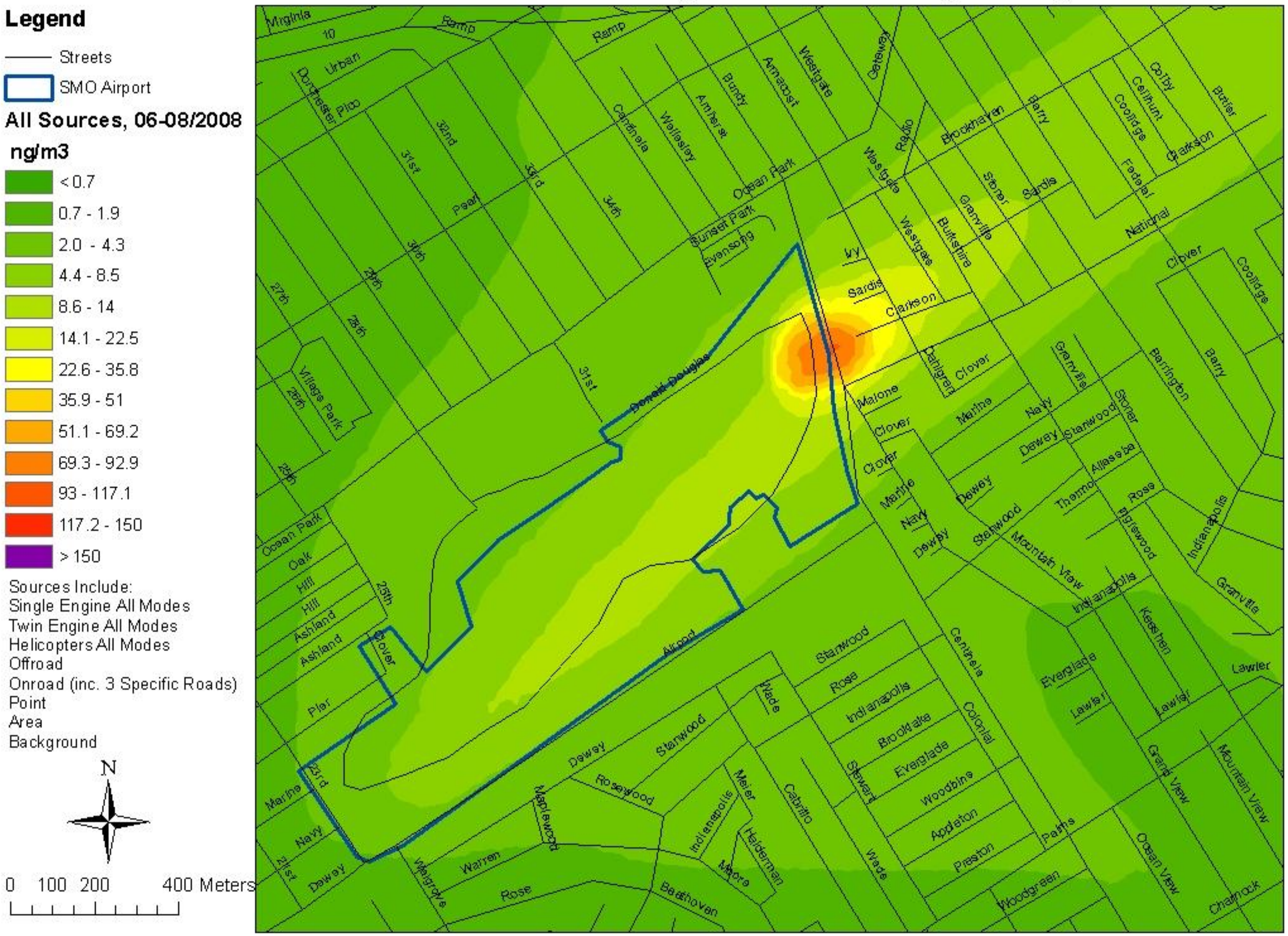
- Modeling results show good agreement with monitored values.
  - 16 data pairs were compared
  - The model results explain 72% of the variability in the monitored results.

Comparison of Modeled Lead Concentration Data to the Lead NAAQS

- The Lead National Ambient Air Quality Standard (NAAQS) was revised in 2008
  - From 1,500 ng/m^3 to 150 ng/m^3
  - The standard is measured as the maximum 3-month average concentration
  - Monitoring is required over a consecutive 3-year period to evaluate all relevant activity and meteorological conditions
- Modeled concentrations at two sites had 3-month average lead concentrations above 150 ng/m^3
- 3-month average modeled concentrations are higher than individual days EPA monitored
  - We did not collect samples over a 3-month period to provide a relevant comparison to the modeled averages
  - Our monitoring site was approximately 75 meters away from the location where the model is predicting the maximum concentrations

Modeled Local-scale Gradient in Lead

All Emissions. Average June through August, 2008.



Baseline (Low Lead) Sensitivity Test. Average Jun - Aug.

Legend

Baseling (Low Lead)

ng/m3

- < 0.7
- 0.7 - 1.9
- 1.900001 - 4.300000
- 4.4 - 8.5
- 8.6 - 14.0
- 14.11 - 22.5
- 22.6 - 35.8
- 35.9 - 51.0
- 51.1 - 69.2
- 69.3 - 92.9
- 93.0 - 117.1
- 117.2 - 150.0
- > 150.0
- Streets
- SMO Airport

Sources Include:
Single Engine All Modes
Twin Engine All Modes
Helicopters All Modes
Area
Point
On Road
Off Road
Background

N

0 100 200 400 Meters

Sensitivity Analysis

- The highest 3-month average concentrations occurred during the summer
  - This period was used in a sensitivity analysis to evaluate activities and input parameters most influential on lead concentrations
- Four factors were found to most highly influence air lead concentrations:
  - Engine "run-up" check duration, taxi-out time, fraction of twin-engine aircraft, and lead concentration in the fuel
  - The two samples of avgas had lead concentrations 20% higher than the ASTM specification
- Additional sites on Bundy Drive near or above 150 ng/m^3 with two scenarios:
  - 2-minute engine run-up time
  - 2.59 g Pb/gal fuel lead content

Roadway Impact on Ambient Lead Concentrations

- Modeled traffic impact on ambient lead downwind from 23rd Street (upwind boundary road)
  - Lead concentrations immediately downwind averaged 0.03 ng/m^3 with a maximum daily value of 0.15 ng/m^3.
- Resuspended soil estimated to add no higher than 0.23 ng/m^3
- Exhaust and re-entrained road dust combined are expected to contribute less than 0.5 ng/m^3
- Results suggest roadway sources are not significant contributors to elevated ambient lead relative to piston-engine aircraft emissions.

Where to Obtain Information

- The final report is posted at: http://www.epa.gov/otaq/aviation.htm

- EPA is responding to a petition requesting EPA to control lead emissions from the use of avgas. Our actions with regard to responding to this petition can be obtained from: www.epa.gov/otaq/aviation.htm