Ultrafine Particles Near Airports
WA State Proviso

• “... the university of Washington school of public health to study the air quality implications of air traffic at the international airport in the state that has the highest total annual number of arrivals and departures.

• ... an assessment of ultrafine particulate matter in areas surrounding and directly impacted by air traffic generated by the airport...

• including areas within 10 miles of the airport in the directions of aircraft flight paths and within 10 miles of the airport where public agencies operate an existing air monitoring station...
WA State Proviso

• ... distinguish between aircraft and other sources of ultrafine particulate matter

• ... compare concentrations of ultrafine particulate matter in areas impacted by... air traffic with... areas that are not impacted by... air traffic.

• ...coordinate with local governments ... share results and inclusively solicit feedback from community members.

• December 1, 2019 submit report.
Outline

• Background on Ultrafine Particles
• Previous Airport Studies
• The Mobile ObserVations of Ultrafine Particles (MOV-UP) Study Methods
• Progress to date
ULTRAFINE PARTICLES
<100 nanometers in diameter

FINE PARTICLES
<2.5 microns in diameter

HUMAN HAIR
50-70 microns in diameter
Sources of ultrafines:
- Diesel exhaust
- Gasoline direct injection exhaust
- Aircraft exhaust
- Other combustion + atmospheric chemistry

Relative Number

Relative Mass

Particle Diameter (micrometers)
Journal Publications on UFPs and airports from Web of Science*

*search terms: “airports” & “ultrafine particles”
A selection of cities with published studies of airport UFP impacts

<table>
<thead>
<tr>
<th>Distance from airport to monitoring site</th>
<th>&lt; 1km</th>
<th>1 to 10 km</th>
<th>&gt; 10 km</th>
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</thead>
<tbody>
<tr>
<td>Tianjin, China</td>
<td></td>
<td>London, England</td>
<td>Los Angeles, CA</td>
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<tr>
<td>Rome, Italy</td>
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<td>Norwich, England</td>
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<td>Taipei, Taiwan</td>
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<td>Boston, MA</td>
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<td>Oakland, CA</td>
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<td>Warwick, RI</td>
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<td>Santa Monica, CA</td>
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</tr>
</tbody>
</table>

*La Guardia
Non-freeway Sampling Routes near LAX

Hudda et al, 2014
Examining Local Background Values Reveals the Aircraft Impacts

- Apply rolling 5\textsuperscript{th} percentile of 1 second data using a 30 second window
- This removes local scale impacts

Hudda et al, ES&T 2014
Area-weighted number concentration equivalent to ~ half the freeways in LA!

$10^3/\text{cc}$

Particle size between ~10 and 30 nm diameter are present at high concentrations at ground level

Hudda et al, ES&T 2014
Review of Health Effects

• The goal of the current phase of the project is to conduct air monitoring to assess ultrafine particle levels near the airport.

• This current phase is not a health effects study.

• For a brief review of health effects associated with ultrafine particles, see slides from our presentation at the Highline Forum on Nov 15, 2017.
Summary

- High concentrations of UFP downwind of busy airports (<20km), but no prior measures at SeaTac.
- The mobile monitoring methodology has been able to reveal downwind footprint in other studies.
- Health effects of UFPs is limited largely to roadway traffic studies, which are suggestive of associations with cardiovascular, respiratory, and possibly cancer health effects.
- Only one airport UFP health effect study that we’re aware of, conducted in Los Angeles on a group of asthmatic adults, which observed an increase in inflammatory blood markers and a reduction in lung function with short-term exposures.
MOV-UP Study

Mobile ObserVations of Ultrafine Particles (MOV-UP) Study

Process

• Form a Study Advisory Group made up of government and non-governmental stakeholders that meets regularly to provide input on the study methods and interpretation of findings.
• Also, meet regularly with the public to provide updates on progress.
• Create a project website to provide updates on study goals, methods, and findings.
• Collect ultrafine particle measurements as directed by the proviso.
• Summarize findings, and make recommendations to the Legislature whether sufficient information is available to proceed with a second phase of the study.
MOV-UP Study
Mobile ObserVations of Ultrafine Particles (MOV-UP) Study
## Instruments used in mobile and fixed location sampling

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Instrument</th>
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<tbody>
<tr>
<td>Ultrafine Particle number concentration</td>
<td>P-Trak 8525 Condensation Particle Counter 3007 NanoScan 3910</td>
</tr>
<tr>
<td>Black Carbon mass concentration</td>
<td>Micro-Aethalometer AE51</td>
</tr>
<tr>
<td>CO₂ concentration</td>
<td>LI-850 Gas Analyzer</td>
</tr>
<tr>
<td>Temperature &amp; Humidity</td>
<td>Hobo T, RH datalogger</td>
</tr>
<tr>
<td>Position &amp; Time tracking</td>
<td>GPS Receiver DG-500</td>
</tr>
</tbody>
</table>
Mobile Sampling Strategy

• Goal of this work: Can we see the UFP footprint?
• Therefore select sampling days when we expect to see an impact (i.e. no high wind days).
• Sample in all four seasons to ascertain the impact of meteorology on the UFP footprint.
• Evaluate impacts: Do we see footprint at both take-off and landing locations?
• Compare results with measurements taken on the same day at ‘background sites’
Southerly Winds

Wind (majority)

Aircraft
Proposed Sampling Routes North of Airport

Holden/Graham

116th

136th

146th

Spokane/Walden
Proposed Sampling Routes South of Airport
Local Background UFP

(Hudda 2014 Method) (Nov 21) Plume Shifting

Predominant wind directions on this day

1\textsuperscript{st} Drive

2\textsuperscript{nd} Drive

3\textsuperscript{rd} Drive (146\textsuperscript{th} only)
UFP size distribution, high traffic site vs. airport site

NanoScan particle distribution, parked sites, 1-min scans, 18-Aug-17

- 138th & 16th S.
- 8th & Weller (I-5)

NS average of 1-min particle number (pt/cm³)

NanoScan Particle size bin midpoint (nm)

11.5 15.4 20.5 27.4 36.5 48.7 64.9 86.6 115.5 154 205.4 273.8 365.2
Recent Monitoring Progress

• 16 days of sampling in February-March 2018
• On 8 days, we utilized two cars simultaneously
• Currently processing the data and running quality assurance protocols
• Refining the methodology for identifying aircraft-related ultrafine particles
Timeline

- Website available: [http://deohs.washington.edu/mov-up](http://deohs.washington.edu/mov-up)
- Study Advisory Group meeting held in January (slides and notes available on website)
- Continuing monitoring in April-May, July-August, October-November.
- Next Study Advisory Group meeting will be in July 2018 to discuss preliminary results, followed by another Public Meeting.
- Solicit feedback from meetings, and draft the report in August 2019.
- Final report by December 2019.
Questions?