Airport Ultra-fine Particles – Webinar for UECNA by Debi Wagner, 6 Mar 2023

TRANSCRIPT, including Q&A

Debi Wagner is longtime activist over Seattle-Tacoma International Airport.

Video: https://youtu.be/irj4jman6sE

Zoom Chat: https://www.uecna.eu/wp-content/uploads/2023/03/20230306-Chat-discussion-webinar-on-ultrafine-particles.pdf

Slides: https://www.uecna.eu/wp-content/uploads/2023/03/UECNA-UFP-presentation.pdf

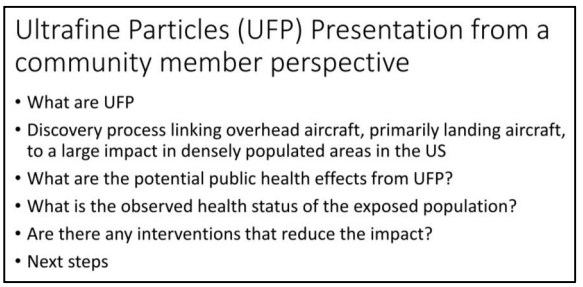
https://uecna.eu

This is an unofficial transcript by Larry Edwards, lightly edited. Chat attached.

Moderator, Dominique: Good afternoon everyone in Europe. Good morning, those in the U.S., especially Debi; hi. Good day to all the Australians who are going to watch this later, online. This is another webinar from UECNA (phonetic Vwecna). This one is going to be on UFPs, ultra-fine particles — a strong subject as the impact on health is very important. Here in the EU, for instances, UFPs are unregulated. So it's going to be hard work to obtain regulations of UFPs, and I am happy to see that Debi is going to tell us more about it. Daniela (sp? Name unclear), UECNA's treasurer and health expert, in Athens, is going to introduce Debi.

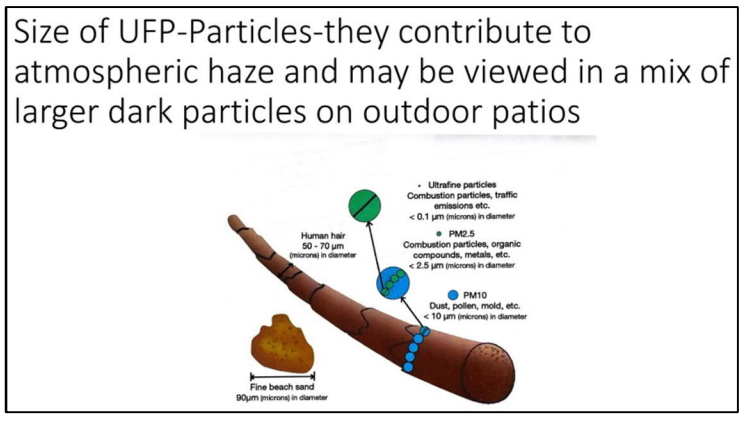
Daniela: Hello everyone. Today with us is Debi Wagner, a Seattle airport neighbor and community activist who worked against the expansion of Seattle Tacoma airport. Since 1993 she has helped co-found the National Aviation Watch organization, a network with other groups throughout the world; gathered data; worked as an elected official to push for better environmental control; led the grassroots organization wrote the book "*Over my head: A memoir of 15 years doing airports environmental justice work*." She's been a community leader in environmental and climate justice, even sued FAA. You name it, she has done it for almost 30 years. Tonight, Debi will talk to us about the theme of ultra-fine particles. Debi, the floor is yours.

Debi Wagner: Hello, everyone. Very nice to see you all. This is a presentation from a community perspective.



I'm not an academic. But I've worked with academics over the last six years at the University of Washington on an investigation of ultra-fine particles. We were looking at relationship between aircraft-sourced ultra-fine particles, and some other questions that we had along the way. I'm going to answer these questions: what are they; the discovery process that led to finding ultra-fine particles sourced to aviation; and what are the potential health effects and observed health status; interventions; and next steps.

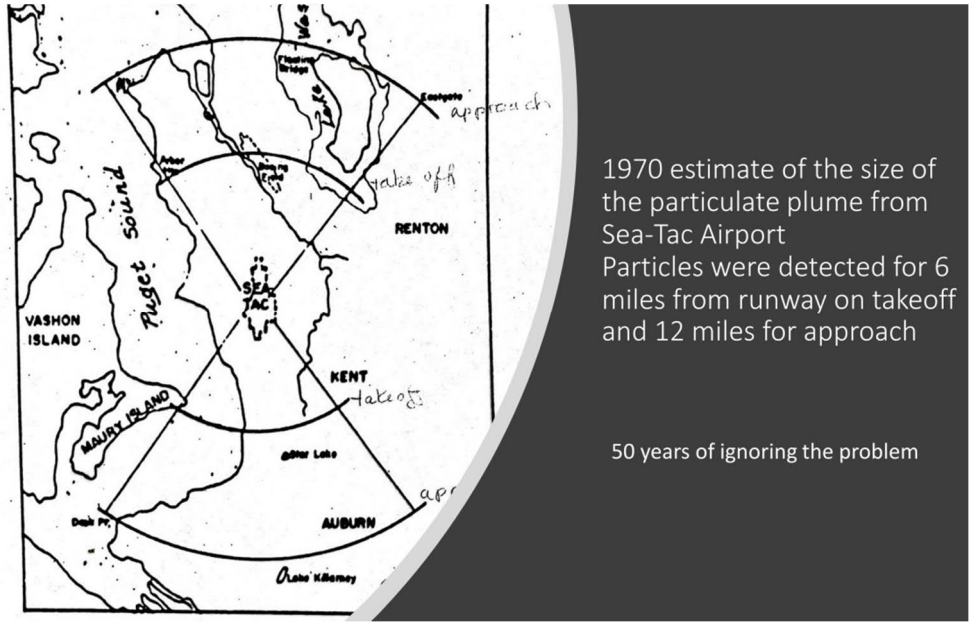
Ultra-fine particles, in case you don't know much about them, are the tiniest particles that are normally looked at in the range of particles starting at micron 10 diameter. And those are regulated in the US — PM 2.5 (2.5 microns in diameter) are regulated. So when you're thinking about ultra-fines, here's the human hair; the PM 10 would be the largest part of that, on the blue, and then the green would be PM 2.5. And then a tiny portion of the screen is the ultra-fine particles. So it's extremely fine in diameter; it ranges from ne nanometer up to 1000 nanometers, and that portion is not regulated. And the reason for it is because particle regulation in the US *is by mass*.



So, ultra-fines are generally too small to create any mass, but they are regulated under

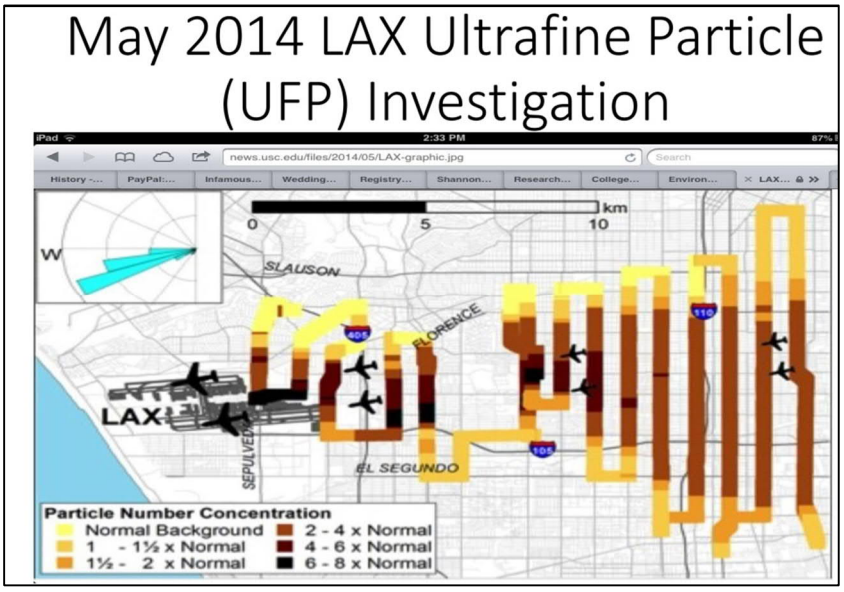
PM 2.5. But they're not really they're not really going to create any kind of mass to come up in the in the regulatory framework.

So Just for history, this map was drawn in 1970. This is SeaTac Airport; that's between Seattle and Tacoma. And this is the area that they mapped out – it's about 12 miles out from the runway end – where you would see ultra-fine particles *visible* on the ground; so on patios, on outdoor furniture, windows, homes.



This was visible in the 1970s, that there was a 12 mile area out from the runway that would be affected by this sooting of property. And that's pretty interesting because it's been 50 years, and not a whole lot was done in that whole interim time between then and now.

The interest in ultra-fine particles began at LAX in in California. Los Angeles World Airports has an airport there with roughly 500,000 to 600,000 annual operations. They are just working on an expansion to increase that. The aircraft takeoff over the water, so the downwind area from the takeoff pattern is directly downwind of the airport, into densely populated communities. So a team that used equipment from the University of Washington and a couple of universities there, did some driving through the neighborhoods with a vehicle that was equipped with testing devices that could look at the ultra-fine particles in the atmosphere. And this was at ground level that the car detected these levels, up to 12 miles from the airport. And these particles were equal to what you'd find in a network of freeways. So it's quite a large amount.

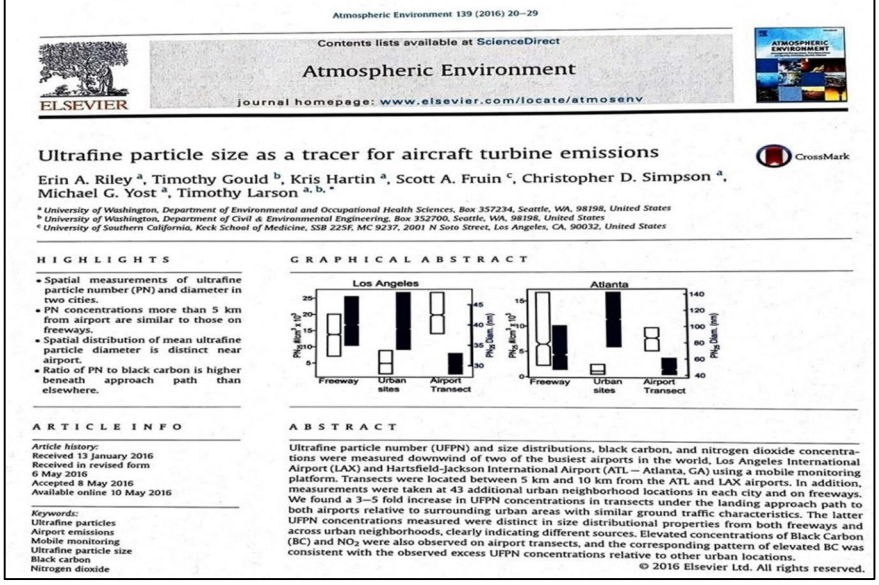


They were very surprised that this, so as a follow up to this study, another one was done around LAX and **Atlanta-Hartsfield Airport** [in the state of Georgia].

Atlanta's airport is one of the busiest in the U.S. (O'Hare [in Chicago] of course, it's the top), but this one has about 700,000 annual operations. The team took the same equipment out to the field and looked at whether or not they could differentiate ultra-fine particles sourced from aircraft versus from ground transportation. What they found were a couple of things that are extremely unique. One is that size could differentiate between the two. The size fraction of approximately 10 to 20 nanometers was what they were seeing in the flight path, where ground transportation typically produces ultra-fine particles in the range of 35 to 100 nanometers.

And another aspect of this, that they found, was that when an aircraft passed over on landing — keep in mind that the majority of the ultra-fine particles are produced from the landing aircraft, *not* from takeoff even though there are some produced when the aircraft are taking off (their engines are operating at maximum efficiency) — when planes are landing and taxiing, they are not operating at maximum efficiency, so you have much more pollution levels, less burning up of the particles and so forth.

Riley, et al, LAX/Atlanta 2016



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Ultrafine particle size as a tracer for aircraft turbine emissions

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HIGHLIGHTS

- Spatial measurements of ultrafine particle number (PN) and diameter in two cities.
- PN concentrations more than 5 km from airport are similar to those on freeways.
- Spatial distribution of mean ultrafine particle diameter is distinct near airport.
- Ratio of PN to black carbon is higher beneath approach path than elsewhere.

GRAPHICAL ABSTRACT

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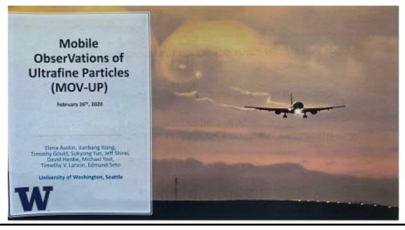
ABSTRACT

Ultrafine particle number (UFPN) and size distributions, black carbon, and nitrogen dioxide concentrations were measured downwind of two of the busiest airports in the world, Los Angeles International Airport (LAX) and Hartsfield-Jackson International Airport (ATL – Atlanta, GA) using a mobile monitoring platform. Transects were located between 5 km and 10 km from the ATL and LAX airports. In addition, measurements were taken at 43 additional urban neighborhood locations in each city and on freeways. We found a 3–5 fold increase in UFPN concentrations in transects under the landing approach path to both airports relative to surrounding urban areas with similar ground traffic characteristics. The latter UFPN concentrations measured were distinct in size distributional properties from both freeways and across urban neighborhoods, clearly indicating different sources. Elevated concentrations of Black Carbon (BC) and NO_2 were also observed on airport transects, and the corresponding pattern of elevated BC was consistent with the observed excess UFPN concentrations relative to other urban locations.

So one thing that they noticed was that after the aircraft passed over the equipment that they had on the ground, shortly after that, they could see a very large spike in ultra-fine particle pollution of this 10 to 20 nanometer, roughly. And each time an aircraft passed, that same spike would happen. Since ultra-fines are so small, they don't coagulate like larger particles and fall to the ground — they drift in the air; in the atmosphere they don't coagulate so they don't necessarily quickly become larger particles.

UW Advisory Board-MOV-UP 2016-Present

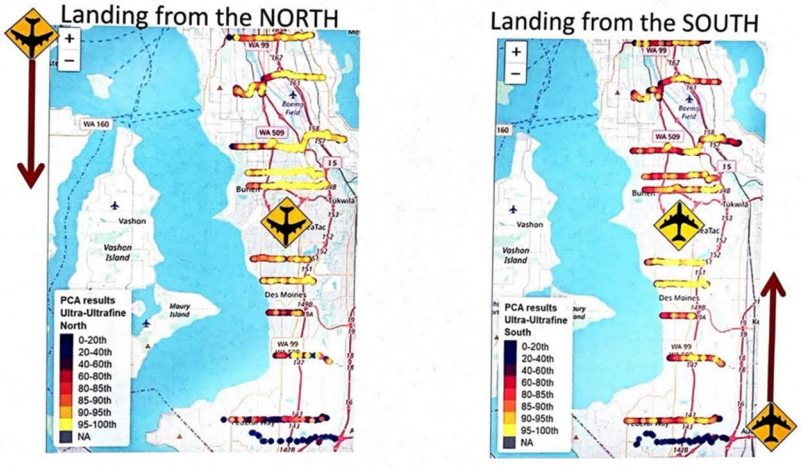


They noted that there was another phenomenon happening — what they found was that the swirling air that's created from the engine movement was creating a vortex where the particles and other things from the engine exhaust were being carried directly to the ground.

That has been duplicated and confirmed and many locations, that there is direct ground-level impact of ultra-fine particles after the aircraft passes. So the **MOV-UP up studies** that have been done by the University of Washington since 2016. (I've been on the advisory board — each time they do a phase of the studies, the advisory board is informed about what's happening). They looked at the same kind of thing that they did at LAX; driving through the neighborhoods to look at the ground-level impact.

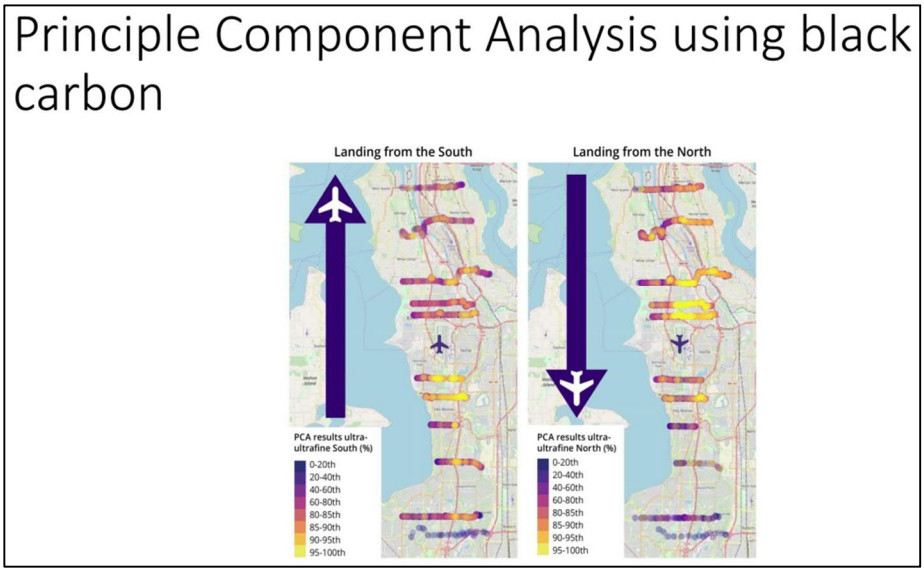
UW UFP Investigation 2016-Present

"Ultra-UFP" tracks landing direction



They found quite a large fraction of ultra-fine particles directly in the flight paths. Not so much on takeoff, you can see how: here's the major freeway network on Interstate 5, and that the majority of the ultra-fines are concentrated more in the area of the freeway. *But here in the path of the planes on landing*, you can see how there's quite a large impact of the ultra-fine particles. What's *different here* is that these are all neighborhoods – they're all single family neighborhoods. So these planes are passing over thousands of homes daily, depositing this, whereas on the freeway level you're going to have actually less of ultra-fine particle pollution; larger particles and more falling to the ground and not necessarily deposited directly into neighborhoods. So that was seen as an issue.

And so a number of people helped to review these slides with me. One of them was a researcher from the University of Washington, who wanted me to bring up the principal component analysis, which was another way to detect a relationship between aircraft-sourced ultra-fine particles, and ground-transportation-sourced ultra-fine particles.



The principal component analysis looked at black carbon ratios, so could also attribute by the black carbon number to aviation as opposed to ground transportation. This was just to check, to confirm, that they were seeing primarily ultras-fines from aviation in the neighborhoods. So the PCA, or principal component analysis, is a second source.

The reason why sourcing is so important is that quite a number of years ago, it's very important to me to find a way to differentiate between aviation pollution and ground transportation pollution in the neighborhoods, because typically airports would like to blame anything but themselves for the levels that you see. And it's been very difficult to find a particular source element – of metal and aerosol, a volatile organic compounds – because all of these are also in ground transportation. There's diesel particulate that comes from trucks that's similar in many ways to the particulate that comes from aircraft. So, *this finding* of the size fraction and the black carbon confirmation has been critical to understanding the differentiation between the aircraft source and the ground transportation source.

As you know, in the 1980s it was important for the industry to try to find a way to reduce carbon monoxide from aircraft, and what they did was they made higher bypass ratio engines that would burn a lot hotter. This in turn created a lot more particle pollution in a smaller fraction; it also created a much greater impact of nitrogen oxides. So I wanted you to be aware that the FAA (the Federal Aviation Administration, which is probably the counterpart to your evil BAA) has admitted that aircraft have a ground level impact of emissions where the aircraft is up to 3000 feet. So that works out to be about a 10 to 12 mile area around an airport, depending on topography.

So the ultra-fines, what kind of health impacts are they responsible for? A few things about Ultra vines that are unique because they can infiltrate deep into the lungs. Because of their size, they're so small, they can cross the membrane barrier in the lungs, enters our bloodstream, potentially affecting all organs and body systems. They're small enough to pass

up the olfactory nerve and enter directly into the brain. And yes, they can pass through walls and ceilings into our homes.

So here's the **Copenhagen Airport** ultra-fine particle analysis on the airfield, you can see that the levels are ranging in some of these hotspot areas of 100,000 to 500,000 particles per cubic centimeter, which is something you would never see from an industry — you just wouldn't see this. It's so a such a large impact.

It's ridiculous. So if you were standing on a freeway, you would get in the range around 60,000 particles per cubic centimeter; normal background should be somewhere 10,000 - 20,000. And in higher urban areas, 30,000. But you would never see 100,000. In that range, it's just astronomical.

So the companion to that, was we did a field test with handheld equipment in a park near the airport. It's about a half mile away from the airport runways. So in this park, when we were downwind with the planes landing over us, and the winds coming off the airfield toward us, we were measuring 60,000 particles per cubic centimeter, and this is in the ultra-fine range. So, 60,000 particles is equivalent to standing on a freeway. So you have to imagine yourself living on a freeway, not in a car, not in a home where you'd have some level of protection, but you'd have direct exposure to the ultra-fine particles all day and all night.

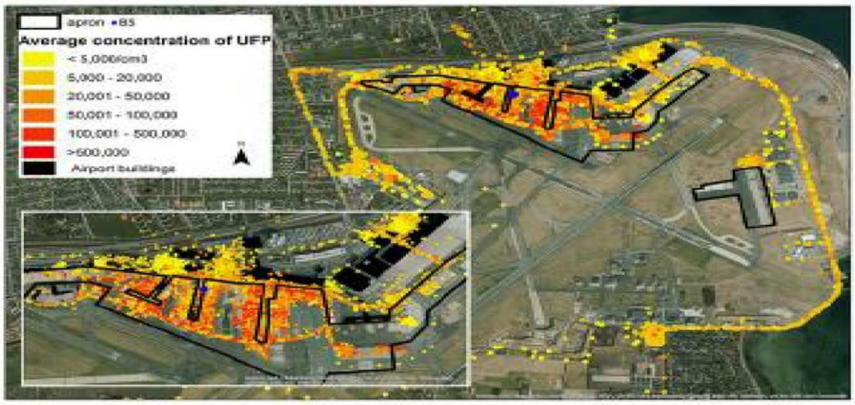
When we walked to the terminal area of the airport, on the drives, it was 117,000. So it kind of validates that Copenhagen, very similar to the outdoor exposure right at the airport. And it's very important that this is an area of public exposure where people are getting out of their cars and going into the terminal. Inside the terminal, it's 4500. So you can see the huge difference that air filtration makes.

Uniquely small particles, not normally observed in the environment, are emitted from aircraft combustion; hi-bypass, hi-ratio engines developed in the 1980's to reduce carbon monoxide produce more Nox and UFP

Typically, ground transportation produces ultrafine particles in the range of 35-100 nm. Aircraft produce predominately in the range of 10-20 nm. This differentiation means that community investigation of aircraft UFP can differentiate aircraft from ground transportation. The UW team has found the large portion of UFP they see is predominately under the landing path of aircraft. FAA acknowledges aircraft emissions have a ground level impact up to 3,000 feet which covers an area of 10 miles around an airport. And unlike freeways, where residents are removed from the source and larger particles typically coagulate and fall to the ground, aircraft sourced UFP exhibit little coagulation, are primarily affecting residential areas and can drift for many miles.

Due to their extremely small size, UFP can:

- Infiltrate deeply into the lungs
- Cross the membrane barrier and enter the bloodstream potentially affecting all organs and body systems
- Pass up the Olfactory nerve and enter directly into the brain
- Pass through walls and ceilings into homes



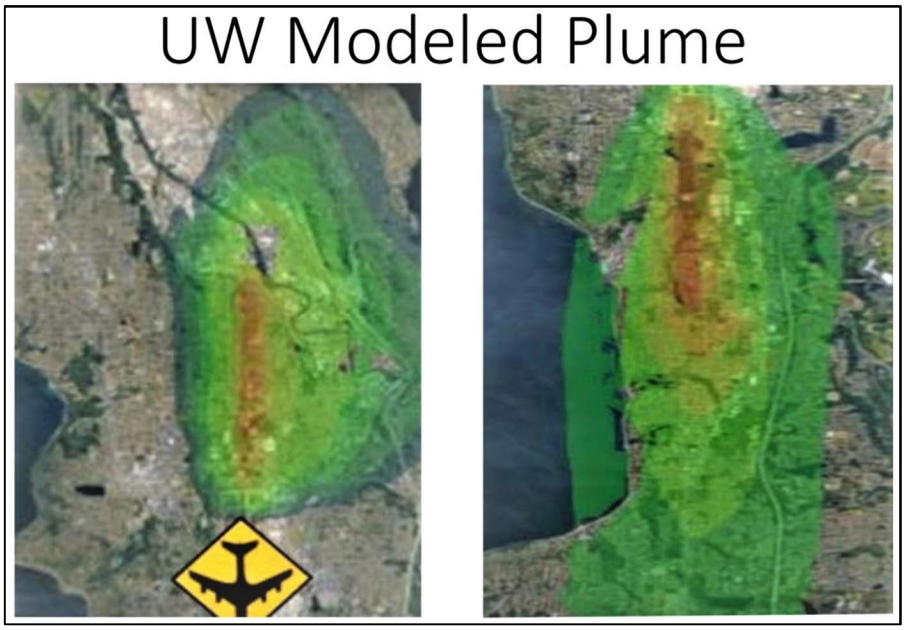
Copenhagen

UFP levels on airport property

Field test of UFP

- A Park about a half mile north of Sea-Tac Airport downwind with planes landing overhead had readings of 60,000 parts UFP per cm^3
- Freeway levels range in this number. When the wind shifted the level dropped to 20-30,000 which is higher than average but more in line with typical background levels in the urban area
- Next to the airport terminal the reading was 117,000 approx. similar to Copenhagen but in an area of public exposure that can have an effect on people with respiratory problems. Inside the terminal building the level was 4,500 indicating great improvement in air quality due to filtration
- Nobody would be healthy for long living on a lane of freeway or working on an airfield but most people are largely unaware of this large plume of pollution.
- Jet engines were modified to burn hotter in the 1980-90's to reduce emissions of carbon monoxide. However, in turn, this created smaller particles and significantly more NOx. It was unknown at the time whether one pollutant traded for another would be as or more harmful.

So the UW also looked at the plume. This is a model plume of where the ultra-fine particles are going in the area. This is actually quite a large area. It's 12 miles out from the runway. It covers many cities that that are surrounding SeaTac Airport and a very large population. This is an idea of the plume that's about 10 miles long and about five to six miles wide. So this plume is blanketing communities where 670,000 people live, and this is daily every day.

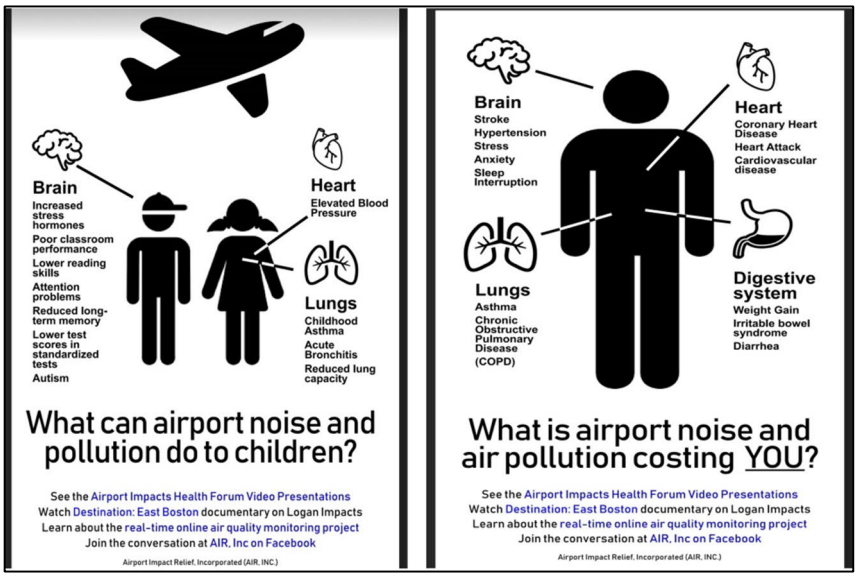


So what do ultra-fine particles do? Well, they contribute to asthma, allergies, respiratory disease, heart attack strokes, cancer. This was a write up on looking at the ultra-fines **at LAX**, some of the things that were very concerning to them. One of the statements here is something that science doesn't know much about. You may be wondering, why would ultra-fine particle concentrations be rising, even when other pollutants seem to be under control? Well, aviation impacts are continuously going up because the industry is driving profits, and that means more business, more operations and more adverse environmental impacts to us.

Ultrafine Particles, not regulated like larger particles but potentially more dangerous

- **What are ultrafine particles?**
- Ultrafine particles are defined as particulate matter smaller than 0.1 microns in diameter.[3] They're mostly generated by combustion reactions that are used to power vehicle engines, industrial facilities, diesel-powered trucks, and aviation engines.
- Current government air quality regulations and standards do not cover UFPs, yet these tiny contaminants may account for more than 90% of all airborne pollution particles.[4]
- Ultrafine particles are associated with:
- - **asthma**[5]
  - **allergies**[6]
  - **respiratory disease**[7]
  - **heart attacks**[8]
  - **strokes**[9]
  - **cancer**[10]
- **Ultrafine particle levels higher than typical near airports**
- UFPs have been found in especially high levels near airports, where airplane engines produce high concentrations of UFPs as they fly across nearby cities and neighborhoods.
- A series of studies commissioned by airport officials and conducted by third-party researchers in the past decade has gradually uncovered that the air quality around the Los Angeles International Airport was not much different from the air quality generally in the region, except for one area of concern: ultrafine particles.[11,12,13]
- These studies reported that ultrafine particle concentrations east of the airport were especially higher than typical levels.
- Airport officials have continuously pledged to continue studying ultrafine particle levels in the wake of these results.
- But you may be wondering: why would ultrafine particle concentrations be rising even when the level of other airborne pollutants seems to be under control?
- Mike Feldman, former Los Angeles World Airports deputy executive director (now retired), noted that the fuel-burning technology that has made jet aircraft more fuel efficient in recent years also produces smaller particles than before.
- "It's something that science doesn't know much about," Feldman has expressed to local newspapers.[14]

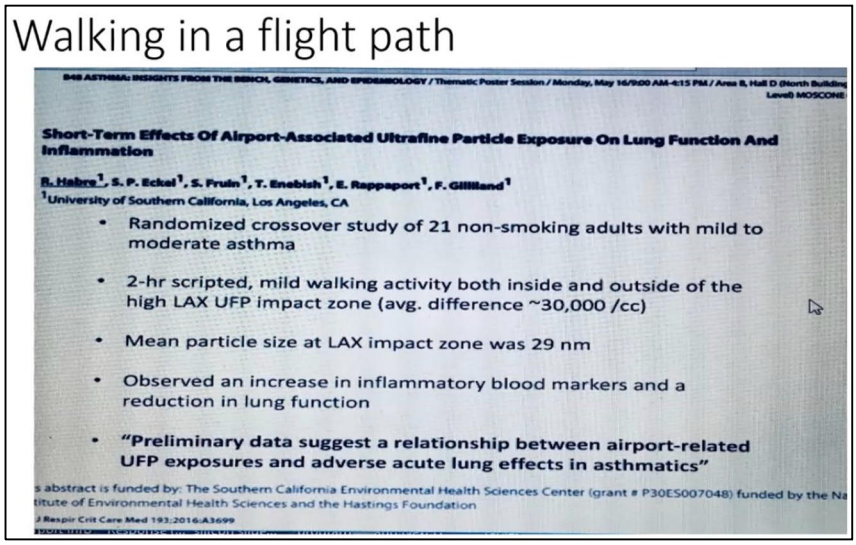
These are a couple of slides that I had from **Boston Logan [Airport]**, showing some of the impacts of the air pollution, and of which ultra-fine particles are only a small portion of the hundreds of chemicals were exposed to from aviation every day.



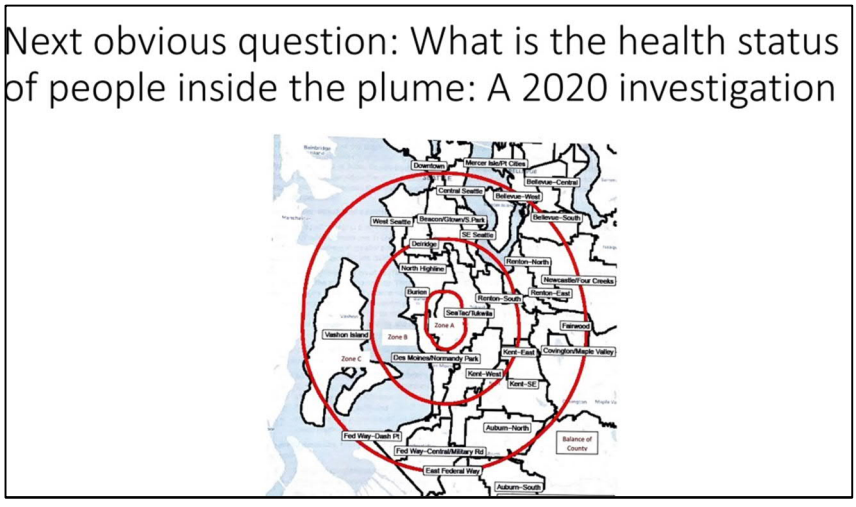
There is some emerging science on the relationship between ultra-fine particle exposure, dementia, Alzheimer's and brain cancer. Researchers are finding a relationship between ultra-fine particle exposures that are high and, and higher incidence of finding dementia, Alzheimer's and brain cancer in those areas.

There's some other stories on different findings of ultra-fine particles and health effects. I've just listed some of those just for your viewing pleasure, I guess.

UW wanted to do an experiment with some people with moderate asthma. So they sent them walking in a park with about 30,000 particles per cubic centimeter — about half of what we found in the park randomly, and had them walk around for two hours, and doing extensive testing. They found that that the ultra-fine particle exposure had a relationship to adverse acute lung effects; an increase in inflammatory blood markers. And we see other thing and a reduction in lung function.



So the next obvious question for our group is, what is the health status of the people that are under the plume? So our King County Department of Public Health got a grant and was able to look at the health status of the people living in that 10 mile area, like I said, there 670,000 people living there.



So some interesting findings. That population group is predominantly low income and minority, and is nearly one quarter of the county's 2.3 million people that are being exposed. Overall, the 24 busiest U.S. airports are affecting 33 million people, if you put that into perspective of a 10-mile area. Unlike freeways of course, there's no mitigation for this impact.

The observed health effects of the people living in the 10 mile area were: a greater percentage of infants born prematurely or with low birth weight; higher hospitalization rates; heart disease; diabetes; asthma; stroke; COPD; higher death rates from all causes; lower life expectancy.

And this was really important: the examination of Community Health is a snapshot of health conditions experienced by people living within 10 miles. Findings demonstrate that disparities are present throughout the life course beginning at birth.

So it's important to know whether or not these ultra-fine particles are infiltrating our homes. A few different studies now have looked closely at that and found a little bit more than half of the ultra-fine particles are coming indoors. So these are the aircraft-source particles in the 10 to 20 nanometer range.

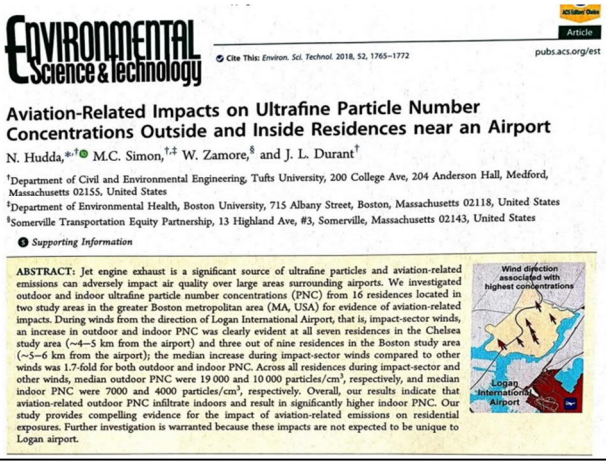
Findings included preterm birth rates are much higher in the ultra-fine particle plume that was found at LAX, somewhere in the range of 20%, higher preterm birth rate.

There was also another **study on noise** that found low birth weight babies were born at 20 to 22% higher rate in a high noise area near an airport in New Jersey. And that study was able to be done because it was *a new* NexGen flight path that started, and that birth rate changed. Much higher rates of low birth weight babies were born after the NexGen flight path started.

King County observed health outcomes

- 670,000+ living in the plume area
- Nearly ¼ of the county's 2.3 million people population potentially affected.
- An exam of US airports found that approximately 10% of the total population is living within 10 miles of a major airport-33 million potentially affected
- Unlike freeways, there are no mitigations for aircraft exhaust which falls primarily onto residents

Indoor infiltration of aircraft sourced UFP



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Aviation-Related Impacts on Ultrafine Particle Number Concentrations Outside and Inside Residences near an Airport

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Supporting Information

ABSTRACT: Jet engine exhaust is a significant source of ultrafine particles and aviation-related emissions can adversely impact air quality over large areas surrounding airports. We investigated outdoor and indoor ultrafine particle number concentrations (PNC) from 16 residences located in two study areas in the greater Boston metropolitan area (MA, USA) for evidence of aviation-related impacts. During winds from the direction of Logan International Airport, that is, impact-sector winds, an increase in outdoor and indoor PNC was clearly evident at all seven residences in the Chelsea study area (~4−5 km from the airport) and three out of nine residences in the Boston study area (~5−6 km from the airport); the median increase during impact-sector winds compared to other winds was 1.7-fold for both outdoor and indoor PNC. Across all residences during impact-sector and other winds, median outdoor PNC were 19 000 and 10 000 particles/cm³, respectively, and median indoor PNC were 7000 and 4000 particles/cm³, respectively. Overall, our results indicate that aviation-related outdoor PNC infiltrate indoors and result in significantly higher indoor PNC. Our study provides compelling evidence for the impact of aviation-related emissions on residential exposures. Further investigation is warranted because these impacts are not expected to be unique to Logan airport.

Relationship between high UFP and pre-term births LAX

Preterm Birth among Infants Exposed to in Utero Ultrafine Particles from Aircraft Emissions Sam E. Wing,1 Timothy V. Larson,2 Neelakshi Hudda,3* Sarunporn Boonyarattaphan,2 Scott Fruin,4* and Beate Ritz1* 1 Department of Epidemiology, University of California, Los Angeles, Los Angeles, California, USA 2 Departments of Civil & Environmental Engineering and Occupational & Environmental Health Sciences, University of Washington, Seattle, Washington, USA 3 Department of Civil & Environmental Engineering, Tufts University, Medford, Massachusetts, USA 4 Division of Environmental Health, University of Southern California, Los Angeles, California, USA INTRODUCTION:

Ambient air pollution is a known risk factor for adverse birth outcomes, but the role of ultrafine particles (UFPs) is not well understood. Aircraft-origin UFPs adversely affect air quality over large residential areas downwind of airports, but their reproductive health burden remains uninvestigated. OBJECTIVES: This analysis evaluated whether UFPs from jet aircraft emissions are associated with increased rates of preterm birth (PTB) among pregnant mothers living downwind of Los Angeles International Airport (LAX).

CONCLUSION: Our results suggest that emissions from aircraft play an etiologic role in PTBs, independent of noise and traffic-related air pollution exposures. These findings are of public health concern because UFP exposures downwind of airfields are common and may affect large, densely populated residential areas. https://doi.org/10.1289/EHP5732

Relationship between high noise (55 db) levels near Newark and low-birth weight

- Now, for the first time, researchers have provided a causal estimate linking high-level noise exposure to another key health challenge: low birth weight (< 2,500 grams or approximately 5.5 pounds).
- Health economists from Lehigh University, Lafayette College and the University of Colorado, Denver were able to pinpoint a causal link by studying residential neighborhoods impacted by recent changes in airplane flight patterns going in and out of Newark Liberty International Airport, one of the largest airports in the United States.
- https://medicalxpress.com/news/2020-07-airplane-noise-negatively-impact-fetal.html

So I wanted to look at infant mortality. And it appeared that there's much higher infant mortality in the areas of the highest noise and high ultra-fine particle pollution levels from SeaTac Airport. Much higher than the average for this is a giant area, with 4 million people are living here.

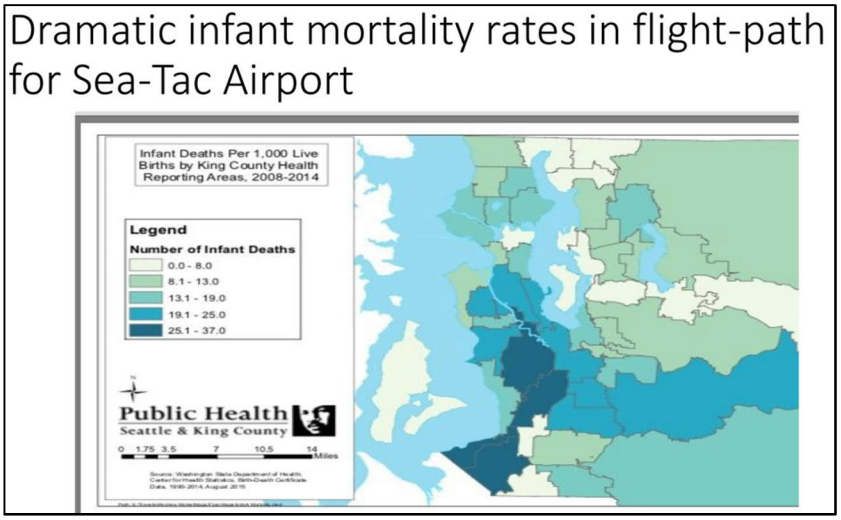
So the MOV-UP study wanted to see what the air was like inside school buildings. So they put equipment inside the schools to measure the difference between outdoor and the indoor infiltration. They found that about 50% of the ultra-fine particles were infiltrating the schools. They wanted to test out interventions to see whether or not using portable HEPA filtration would help, and the HEPA filters inside the classrooms, were able to reduce the ultra-fine particle pollution by about 75 to 82%. So those have now been deployed in a number of classrooms throughout the school district.

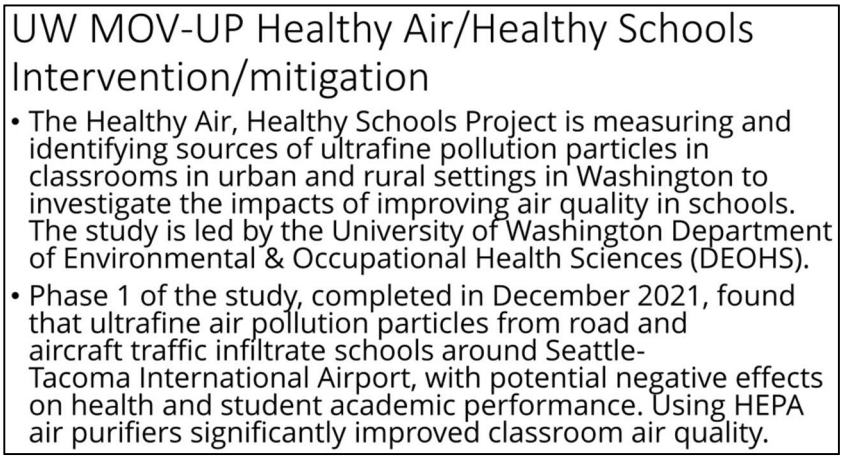
And another question that the MOV-UP group had was, what's on those particles? Are they loaded with toxics and metals and other things that once they get into the full body systems? Are they contributing to cancers and other debilitating diseases? So that's the next phase; we're looking at that with a piece of equipment that can separate particles by size, and then look at content for metals.

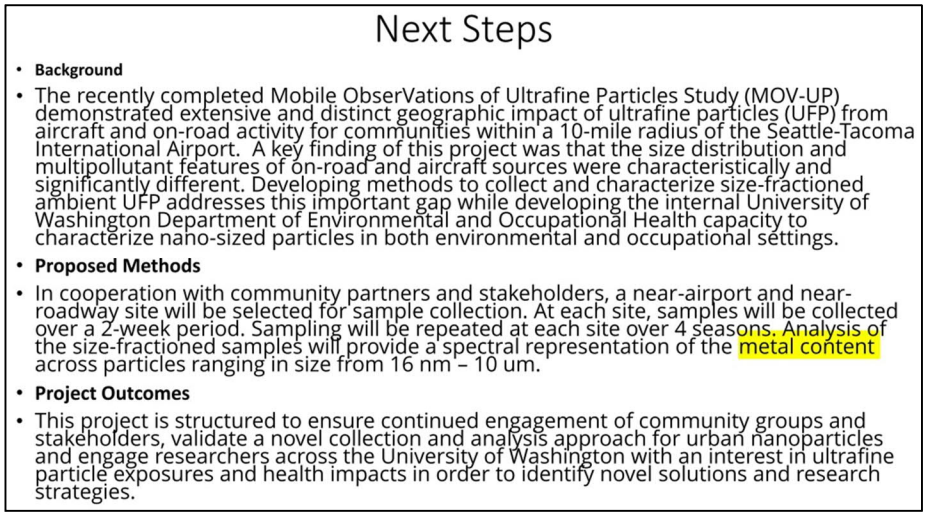
So here's some references. And that's the end of my presentation. (29:00)

UW MOV-UP:
https://deohs.washingtgon.edu/mov-up

Health in Aviation Impacted Communities: Community Health and Airport Operations Related Pollution Report







Q&A — John Stewart (moderating):

Thank you very much indeed. That's brilliant. And now we can see everybody's faces on the screen, which is great. Debi, that was, that was just wonderful. For so long, people have been asking us to do a webinar on ultra-fine particles, and we found the right person to do it. That was that was just great. If people have got questions and comments, as ever if you can raise your hand, either your real hand or your automatic or your yellow hand. And I'll come to you.

And as I say every time it's easy for me, my native language is English. If your native language is not English, and you're a bit hesitant to speak in English, don't worry, you're amongst friends, many other people will be in the same boat. So just have a go. Pete your first.

Pete — Thank you very much. Yeah, my name is Pete, working in Imperial College on fine particles in my in my experiment over there [pointing across lab]. But my question is about the conclusion that higher efficiency of burning led to fewer particles. I just wanted to check that that was right, because I'm not sure if burning at higher efficiency produces a different size of particle?

Debi Wagner — Yes, that's a great question. It actually has been hypothesized that the higher temperature and a higher bypass high ratio meant to burn a lot faster, work a lot faster; it would burn more fuel, but it would be more efficient with reducing carbon monoxide because of the heat.

So it's been hypothesized that that's created more particles and smaller particles. That may or may not be true; that hasn't been proved out. But in field testing and observation, when planes are taking off at the same level (as when they are landing) there's not that observed rate of particles coming directly to the ground, as there is on landings.

So some of these are things that need to be further tested out, but it's interesting how much is thrown out there on ideas of why these things are happening, like the vortex or like coloring omissions, cloud white, that sometime, you know, in the future, we may know more. But it takes – you know, you're a researcher – it takes a huge amount of money, large amount of effort to investigate these things thoroughly.

Pete — Yeah, I had a follow up about how sustainable *sustainable aviation fuel* might have different size distributions, might — like does that means greater numbers of ultra-fine particles?

Debi Wagner — Yeah, the FAA has done a lot of testing on the SAF, and at the tailpipe it's not going to make any difference. It will reduce particles, but it depends greatly on the type of fuel. And there's a large variety of different types of sustainable aviation fuels that have been proposed. And nobody knows how sustainable any of those are; we're going to use up all our food crops. You know, when you're pumping 2 million gallons of fuel a day at an airport, we're talking about 35 billion gallons a year (I know you're in liters) being used in the US. That's an awful lot of meat crops or wood waste, or biomass or

Pete 32:25 — Yeah, a recent investigation from Imperial showed it was around half of all agricultural land would need to be used to make all of us British flights run on sustainable aviation fuel.

Debi Wagner — Right. And as far as testing out the tailpipe, not a lot has been done. But you're not going to reduce any climate impact at all from the tailpipe. And that's the elephant in the room. So if you're only going to do supply chain, you know. Airports like to do something kind of tricky with the climate impact. They like to separate out different *areas* of impact. So like SeaTac Airport calls it scope one, scope two, scope three. Jets are in the scope three, and they never talked about that. So they're reducing scope one and scope two by 3%. It's only 10% of the impact. The 90% is going up by more than what they're reducing the other scopes by, but they don't talk about it because they don't ICOA in charge. ICAO

John Stewart — Great, Debi. Thanks very much. And I love someone who talks about gallons. It's a language I can understand. Okay, Elaine. Welcome.

Elaine — Good morning, good afternoon, good evening to everyone who's attending today. And thank you, Debi, for such a wonderful presentation. Your information is so valuable to all of us. I just wanted to ask the question; I don't know if this will relate or not. But if we go

to 5G Towers, and if there are any medical components or anything on these ultra-fine particles, will that affect that in any way?

Debi Wagner — I don't know. I know people are concerned about 5G having other effects on human health. So these cumulative impacts are, they're never just isolated. This is something I didn't talk too much about; just a little bit with the infant issue is that you can't say well, here's what's what noise is doing to us and then separately here's what emissions are doing to us, because we're subjected to both.

So your airports are probably the highest emitter in your region, your country may be in quite a big area, where you can look at other emitters and see what the levels of overall pollution are. Airports are a major significant contributor. They're greater than steel mills, refineries, coal fired power plants. The number of pollutants and the types are very dangerous, and that combined with noise, combined with 5G, combined with acid rain, combined with climate — it's not that 'Oh, climate is doing this to this group here'. No, it's an overall impact in our westernized society, we're being bombarded.

And one thing the aviation industry likes to do is to say, 'Well, you can't prove that that person's lung cancer is from our aircraft production of soot, because there's so many other things in the environment'. Well, it just exacerbates, it makes it worse. So cumulative impact is important. You want to avoid the 5G, the aircraft flight path, the coal fire downwind sulfur plume, whatever you *can* avoid you want to avoid, but I don't know of a relationship between ultra-fines and 5G.

Elaine — Okay, thank you very much.

John Stewart — Thanks, Debi. And thanks for Elaine for the question. No more hands up at the moment. Yes, Juergen, a real hand; unmute yourself and ask your question, if you will.

Juergen — Thank you very much for the presentation. Reminds me of my time at UW but I lived in Wallingford, north, so it looks like I was safe. Anyway, two questions. ...

Debi Wagner — This presentation is very different than the research because I only teased out what parts I thought were important for us as people living under the planes. Researchers typically look at things a little differently; they want to present their quality assurance, the underlying basis underneath their equipment that they use, how they did the testing, that kind of thing is but it's all fascinating, so I'll get the link for that as well.

Juergen — One final question. We are all in the same business, that arguments are difficult and as you alluded yourself, it's very difficult sometimes to convince people about the hazards of ultra-fine particles. In your opinion is there good literature that separates the ultra-fine particles from aircraft noise as a health hazard, or is it just something like where they use principal component analysis to make correlations, with this being believed by people like us, but not people in regulatory positions?

Debi Wagner — Well, there is a case to be made for regulating ultra-fine particles, just because they are considered as emerging that they're more dangerous than the larger particles. Larger particles don't necessarily infiltrate as deep into the lungs as the ultra-fine particles. So body systems are much more susceptible to harm, especially if these particles are carrying different, you know like I talked about, metals and organics and stuff like that.

But the regulatory agency, to make an argument because they regulate by mass, would have to be a different proposition for them to regulate ultra-fine particles. Right now EPA, our main Environmental Protection Agency, is trying to defer particle regulation from aircraft over to ICAO. What's bad about that is ICAO makes recommendations. They don't have any enforcement mechanisms for compliance. I don't know; there's a love affair with aviation; everybody wants to turn a blind eye to it. So I don't know if that answers your question.

Separating it out from noise saying it's a different impact that needs regulatory control; that's absolutely true. But getting there is quite a quite a problem.

Monique (moderator) — Debi, on this point I doubt that the WHO has only recommendations on monitoring the ultra-fine particles, nothing on limiting the number of the particles. So we need the WHO to act, and at least have a recommendation that they should be limited, not just monitored.

John Stewart — Thanks, Dominique. I'll come to Ruggerio first, and then to Martin. Ruggerio from Brazil.

Ruggerio — Oh, thank you, John. Hello, there. Thank you so much for your great presentation. What I want to point to you is that on your study, have you measured some people who are on direct path of the gases that are flowing out of the engines?

I say that because here at Pampulha Airport in Brazil, the hangers are just like 100 meters from on the back of my house. And active jets taxi from east to west, and we get a wind blowing to our house. And when the jets taxi on that direction, I get a very strong smell of kerosene burn, a very strong smell that we have to shut the windows, close the door and hold the breath and then sometime have to leave the room because it's so, so intense. So what is likely the proportion of ultra-fine particles, being that we are on the direct path of this move, from your observations?

Debi Wagner — Well, you're probably getting a heavy dose because like I said, in the park there that's a half mile from the airport we found 60,000 particles per cubic centimeter of the ultra-fines, not near any roadways at all — all this was completely attributed to the airport blowing toward us from a half-mile away. So it's going to be a huge impact.

You saw the Copenhagen look at the ultra-fines around the tarmac were in the range of 100,000 plus particles, double a freeway lane. I mean, how long could you live standing on a freeway lane, your home provides some amount of filtration. But to really reduce the indoor impact level of the ultra-fines, because they're coming in through your walls, you should use a portable HEPA filtration. And here in the U.S. you can buy those for about $500 to $700; I don't know they're lifesavers, though. They're kind of expensive, but they're reducing the impact indoors by 75 to 82%. And you want to have reduced impact as much as possible.

But when you go outside you don’t have any protection at all. The amount of air toxics and other criteria pollutants – so sort of defined as you know the hydrocarbons, volatile organic compounds, and then things like carbon monoxide, ozone, nitrogen oxides, sulfur dioxide, and particulates – they're producing, like I said, equal to and greater than steel mills. some refineries and incinerators. You're living right next to probably the greatest pollution source of air pollution anywhere in Brazil.

John Stewart — As people will know, from what Ruggerio said in the past and people are very, very close to Bella Rosante airport, don’t they, Ruggerio?

Ruggerio — Thank you, for these observations.

Martin — Ruggerio, you live on the flight path, you live on the on the piste, your life is on the runway; it seems to be so close. It's unacceptable at all. You have more exposure than people who work at the ground of the airport. It's unacceptable, what you report to us; it's unbelievable.

I want to come back to the question of Juergen that was the question about if we could separate the impact of air pollution of yours UFPs and noise, and the health impact of both, if we could separate this. Or if we could have any coalition. In Frankfurt area where I'm staying, the noise measurement, and the correlation between noise and ultra-fine particles. We’re the point where everything started more than 10 years ago.

So we had the noise impact on the area, we could measure the noise impact. And then the group and some are listening today in part here, they started to measure the ultra-fine particles at the same flight path area where we measured the noise. And then they could see the noise went up and the ultra-fine particles went up as well. So there was a correlation. But your question, Juergen, was if we have any separation, we could say this is coming from ultra-fine particles and this impact is coming from noise, this will never be possible even for one of the two, it's difficult to give any qualified statement. Number of people are living under the flight path. Area people are migrating in and out. Long time study the health impact of whatever, it's very difficult to get this under control, even you have all the data one day of the social insurance, you can never say this 100,000-200,000 people got this and this kind of impact by this environmental disturbance. This is where it's difficult to make any quantified statement. What is clear is that there is directly a correlation between the noise and the ultra-fine particles at the landing side of an airport, like you described; that the landing site has more impact than the starting side.

And we could see this. And what is now very important as well is to see that the the ultra-fine things are like in a cloud going around at the airport ground. That means not only the airport space itself, but as well, some kilometers around where you have houses where you have offices where you have freight, often, or you have a company's established. So this is a very critical area to work. And to stay. I live I work as well, at the moment five to 500 meters from the airport. So I work everyday as well in such an area where it's a high impact of the ultra-fine particles. And this is clear; the wind is bringing these fine particles always into the housing areas. It's not only the airport; it's as well the beside areas that are very high affected. You, and this is new for the last couple of months, is that there is as well not only the kerosene that is burnt or less burnt at landing, but there is as well an oil that is used in the engines. This oil leaks as when it is burnt has an impact on the fine particles. This is a kind of a technical oil that is burned. Thank you.

Debi Wagner — I read about that recently. Thank you so much, Martin, because those are great observations. And I love what you said about it the difficulty in separating out the noise and emissions and the impact analysis. It's extremely difficult because like you said, each person reacts differently. And there's a zoo of chemical pollution going on at airports. So somebody will be affected more by one or the other or by noise. And then you've got body systems being broken down from sleep loss and stress and anxiety. And on top of that you've got the ultra-fine particles coming into the house that were reducing lung function, affecting the brain and thought. You know, they've observed brain changes in children exposed to ultra-fine particles for a period of time. And these effects are just not limited at all. But they're different for people as everybody reacts differently at different levels. Some people are very resilient. Ruggerio, I imagine you must be a tank of resilience living right next to the airport, when we can still talk to you and see you.

John Doherty — Debi, thank you very much. That was a very precise presentation. It's explained quite a lot to me. I haven't done the study till now. I live in southeast London, and that is our misfortune to live under a double overflight position. In bound aircraft into London City Airport, they fly over us at less than 2000 feet on a 22 kilometer long path, which is a non-CDA approach. So we've got engines gunning along that 22 kilometer path to maintain that 2000 foot height, and to turn the aircraft around corners, as they say.

The other factor is that we also have to endure London Heathrow inbound flights at 3500 to 5000 feet above us, albeit they do use a CDA approach and the aircraft are more akin to gliding into the airport to a standard 3.1 degree approach.

My fear is that perhaps in my situation, my locus, that we are more exposed than most might be. Do you think the concept of aircraft not using CDA and having to employ the engines

greater for better periods, gun them more if you like, to maintain those heights adds to the problem?

Debi Wagner — Well, I don't know how much control anybody might have over the glide path and safety. I know on takeoff, they can do a higher climb, and get up higher before they start reaching communities, because they do that at John Wayne Airport in California. But this glide path, if they're going to have NexGen, they gotta concentrate these planes and have them at different heights and planes are coming into the glide path. I don't know that you could raise or lower that without creating issues with your safety with your regulatory.

John — We do have some issues with some resistance from the regulatory body and from the operator himself, having implemented a poor quality design for a flight paths on five or six years ago, and being unwilling to engage in a process to collect that data. But that exact context of the double overflight, and with an unwillingness to vet it in the meantime — as a follow up and forgive me, Debi — this may not be one that you can answer. I wonder if Pete, who spoke earlier, do we know of any certified bodies in Europe who are undertaking these measurement exercises, that potentially we could go to it and get some definitive data?

Debi Wagner — I think in Copenhagen they did a lot of work on this. So I'm not sure but I'm in touch with the researchers that are we're looking at aviation impacts in the US. I can certainly ask what research is being done in Europe. We did hear from Martin that they are looking at, or somebody else.

But I think Larry said it best [in the chat] that you have to reduce the impact; so reducing aviation operations. Or making an understanding of letting us know where is it safe to live; Is it safe here? Because we have no idea. We're taking a gamble. And the risk is there. The risk is evident. We're taking a gamble with our health. We don't know where it's safe to live, or how far away from an airport. And I don't see airports buying out this concentrated path that they want to implement everywhere. They're not buying this out to make it a clear like Elena Freeway. If you were putting in the Elena Freeway you'd buy out the people living there. They you'd have to get them out of the way. But they leave us.

John Stewart — Helen Kirk put in the chat, ‘Can we have a transcript?’ Yes, how we do save the transcript of the chat. And that can be that can be circulated. So, Walter, I think you may be the last question before I hand back to Dominique.

Walter — Yes. It's not a question, but it's an answer. Also in Amsterdam, Schiphol Airport, we have the research, and it was very clear that they also find particles had effects on children with health problems with their lungs. I put the link in the in English in the in the chat, and I will put it on the website when we end this, this meeting.

Debi Wagner — Oh, I just wanted to say that that is one thing that is the difference; that the noise is contributing to learning loss. And you *know* that the ultra-fine particles play most likely a big part in asthma rates and the lung and COPD problems. So for someone who's looking for a separation of where do we see the difference in the impacts? The health study that was done in our area showed quite a bit of learning difficulties on the part of children, as well as the asthma rates and hospitalizations. But then again, children that spend a lot of time in the hospital might not be reading. So factor education, too. So how do these play against each other or — they're all concomitant, though they're cumulative, and they're multiple impact.

John Stewart — Debi, just thank you so much for that. That was incredibly informed, incredibly informative.

Debi Wagner — Thank you so much for inviting me. I really ...

John Stewart — No, keep this up, Debi, and we’ll be inviting you back for round two. But thanks. Thanks so much.

Record of the Zoom chat:

00:29:17 Robert Buick: The 3000' feet is significant, as our 'evil' UK CAA state that it is only 1000'.

00:37:38 Carla (aka LaKunaBi ....;-): where I could find the slides/ recording later (soon ;-)? As from to tomorrow until the 9th I will participate at the ITB (International Tourism fair) here in Berlin... where I could meet also People from Airlines, but also concerned communities, I suppose

00:38:42 Dominique Lazarski: here are all our webinars and related documents https://www.uecna.eu/our-webinars/

00:40:48 Robert Buick: I'm stunned, I knew it was an issue, but no idea it was this bad, thank you so much for sharing

00:43:05 Carla (aka LaKunaBi ....;-): Q: Are there also results on the effect on agriculture products and their influence on health?

00:45:33 Martin Kessel: From Frankfurt/Germany area we may confirm, that the impact of UFPs is higher at the landings, not starting planes.

00:45:35 Gretl Gallicchio-10,000 Hawks: Ms. Wagner--THANK YOU for this presentation! Might you be available to consult by phone or email? My group is currently engaging FAA in EA public comment re local airport expansion. Trying to get an EIS. hawks@10000hawks.org or gretl@att.net

00:45:41 Carla (aka LaKunaBi ....;-): 1 gallon in Liters? ;-)

00:45:43 John Doherty , London: I find it hard to believe our airport operators do not tell us the truth and set out to obfuscate hard fact.

00:45:43 Robert Buick: Different sized gallons

00:47:11 John Doherty , London: Our experience with London Airport Operators is - they impart terminological inexactitudes at every opportunity.

00:49:15 Dominique Lazarski: https://www.uecna.eu/our-webinars/

00:49:18 Yves Tuffet: Do regular fliers run risks for their health? When they are on the plane, do they breathe inparticles?

00:50:04 Martin Kessel: One million Gallons a day maybe right. we have similar figures of kerosene tanked dailyin Frankfurt. An airport is a large, very large gas station!

00:51:01 Carla (aka LaKunaBi ....;-): @ Martin Kessel: where I could find data for Germany or around? (as one aim of ITB is also to get again more tourists from oversea)

00:53:43 Larry Edwards, Sitka, Alaska: How could aircraft ultra-fines be regulated? Would not reducing fights be the only effective way, for conventionally powered aircraft?

00:53:47 Wouter Looman: Ultrafine particles in the vicinity of Schiphol Airport affect health: https://www.rivm.nl/en/news/ultrafine-particles-in-vicinity-of-schiphol-airport-affect-health

00:54:18 Dominique Lazarski: @Larry, sure, the only way

00:55:13 Dominique Lazarski: aromatics and sulphur are necessary today in kerosine, there will be ultrafine particle until they find a way to remove them

00:55:51 Joan McIntyre: https://www.sciencedirect.com/science/article/abs/pii/S1352231021000443 This research suggests aircraft departing emit particles in much higher numbers than those arriving.

00:57:07 Pete K: You can make your own air cleaner very cheaply and they are extremely effective: https://youtu.be/CXa8auzKx9Y

00:57:08 Larry Edwards, Sitka, Alaska: So we should call "regulation" what it needs to be: reduction in flights, perhaps taking into account the cumulative gross weight of aircraft per day.

00:57:24 Dominique Lazarski: @joan the difference is with the altitude. landing means low altitude for a longer time than taking off

00:58:52 Gretl Gallicchio-10,000 Hawks: @Larry--absolutely correct!

00:59:22 Carla (aka LaKunaBi ....;-): how to help help/support perhaps the Dutch Government, which is sued by airlines on flight caps? https://www.bbc.com/news/science-environment-64842394

00:59:55 Dominique Lazarski: @Larry / same as for NOx

01:00:04 Dominique Lazarski: and noise

01:00:14 Larry Edwards, Sitka, Alaska: ++

01:00:18 Pete K: Here is my ultrafine particle measurement setup for anyone interested, at Imperial College in London

01:00:46 Dominique Lazarski:

01:01:14 ELEFTHERIA EMFIETZI GREECE: Reacted to "20230306174949000.jpg" with

01:01:21 Catherine Stolbowsky Abile-Gal -Toulouse - City of Airbus: What about people working in the airports, do we have studies on the impact of those particles on their health ?

01:02:00 Gretl Gallicchio-10,000 Hawks: @Martin--can you share the name of that oil, if you have it close to hand?

01:02:10 Carla (aka LaKunaBi ....;-): I had also heard that planes dump unused fuel before landing - does anyone know if this is still the case - and to what extent - and what effect it has and where to find good illustrative sources/graphs?

01:02:42 Dominique Lazarski: Catherine, / I remember attending a presentation of health impacts of aviation on airport employees.… they appear in better health than the rest of the population.… I had doubt on the study

01:02:52 Yves Tuffet: I have heard that too.

01:03:19 Catherine Stolbowsky Abile-Gal -Toulouse - City of Airbus: LOl Dominique.…

01:03:24 Catherine Stolbowsky Abile-Gal -Toulouse - City of Airbus: LOL

01:03:30 Dominique Lazarski: no dumping of fuel unless danger / kerosine is too expensive

01:03:50 Dominique Lazarski: now new aircraft can land at almost the same weight as for take off

01:04:38 Pete K: Carla, I spoke with a pilot who talked about fuel dumping here: https://www.podbean.com/ew/pb-7rdsh-119349d

01:06:27 Helen Kirk: So much info in the chat that I'd like to look at - could we have a transcript please?

01:08:40 Bridget Bell: Any comment on the impact of UFP to those flying? Or working in the airport

01:08:54 John Doherty , London: Fine looking piece of kit, Pete - can it be transported to my location in SE London.

01:09:08 Jane: Debbie, thank you for a very interesting presentation.

01:09:09 Carla (aka LaKunaBi ....;-): If anyone has ideas on how to tackle the various problems mentioned today, e.g. with AI (artificial intelligence), please send them to me - I am in contact with the AI Citizen Science Workshop.

01:09:27 Dominique Lazarski: https://www.uecna.eu/our-webinars/

01:09:35 Martin Kessel: the technical oil burned inside the engine is not Kerosene. It's a kind of an oil that is making gliding mechanical parts and gets burned. It's a Synthetic oil. will check the technical specs and inform you later. Martin

01:09:40 Bridget Bell: And to add to all those thanking you Debi I am adding my thanks.

01:09:52 Gretl Gallicchio-10,000 Hawks: Thanks so, so much to Debi and everyone at UECNA!!

01:10:03 Jos Jonckers: The environmental agency here did a study in 2016 on UFP around Brussels Airport. Study is in Dutch though. Will send main findings to UECNA.

01:10:10 Carla (aka LaKunaBi ....;-): concerning Ai-ideas send it to lakunabi@posteo.de

01:10:17 Gretl Gallicchio-10,000 Hawks: And thank you, Martin!

01:10:32 Debi Wagner: https://deohs.washington.edu/mov-up

01:10:51 Carla (aka LaKunaBi ....;-): Also send me Questions/ demands to aircompanies I could ask them at ITB here in Berlin the next days

01:13:18 Carla (aka LaKunaBi ....;-): lakunabi@posteo.de

01:15:59 Dorinne Tye: Perfect point! Yes, I also believe the cost/benefit remains incorrectly l opsided!