**Conversations After the Fires: Air Quality and Health**

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**Caltech Science Exchange**

Transcript

Lori Dajose:

Hello, and welcome to Conversations After the Fires. If you joined us last time, welcome back. Thank you for joining us. My name is Lori Dajose, and I am a science writer at Caltech.

Today, we're going to be talking about a topic that affects all of us in the LA region, and that is air quality. As we know, the Palisades and Eaton fires released smoke, ash, and all kinds of particulate matter into the air we breathe. And, today, we're going to talk about efforts to measure air quality, and what folks can do to keep themselves safe and healthy.

So without further ado, I'll briefly introduce each of our panelists. Haroula Baliaka is a graduate student in environmental science and engineering at Caltech, and a leader of the PHOENIX Air Monitoring Project in the Pasadena area. Sina Hasheminassab is an air quality scientist at the Jet Propulsion Laboratory, who has been installing sensors near JPL and Pasadena since the fires. Rima Habre joins us from USC, where she studies the effects of air pollution on the health of vulnerable populations. She's a member of the LA Fire HEALTH Study run by Harvard Chan School. Also a member of the LA Fire HEALTH Study team, Lea Hildebrandt Ruiz joins us from UT Austin, where she is a chemist studying harmful air pollution. She also did her undergrad here at Caltech.

All right, Lea, since you were one of the first in this group out there taking new measurements after the fires, let's start with you. And first of all, can you tell us what the LA Fire HEALTH study is?

Lea Hildebrandt Ruiz:

The LA Fire HEALTH Study is a large research consortium that aims to evaluate which pollutants are and were present during the fires, at what levels and where, and to assess the health impacts of those pollutants. And the focus of the LA Fire HEALTH study is the Eaton and the Palisades fires and surrounding areas. It's funded initially by the Spiegel Foundation of Los Angeles, and it's a large research consortium including several different research groups and research universities. Among them is the Harvard School of Public Health, and then also our research team at UT Austin. So here is the link to the LA Fire HEALTH website. And I just wanted to point out that on that website we have many different resources for communities, among them, under the data resources, we have published several data briefs where we share early insights and data relevant to the LA fires.

At UT Austin, our research team, which has been led by my colleagues, Dr. David Allen, Dr. Pawel Misztal, and myself, we've been doing measurements. We've also done some modeling work, but I'll focus today on some of the measurements we've been doing. Of course, those are just the PIs, and our research team is a fairly large research team. Here's a picture of some of us in the field in February. So we were not taking measurements during the LA fires. We arrived in Los Angeles on February 1st, which was after the fires, and also after the first main rain event, after the fires.

So here's how we take measurements. We have this mobile van. It's also in the picture in the background here. So this is a cargo van. It's a fully electric vehicle, so zero emissions, and that's very much on purpose, so when we take measurements, we don't have to worry about accidentally measuring our own emissions. And the van has several different instruments, two main instrumentations. One of them is an aerosol mass spectrometer that measures particulate matter concentration and composition. And the other one is another mass spectrometer that basically measures gas-phase species.

So since I mentioned particulate matter, I just wanted to introduce that a little bit more. So particulate matter, or atmospheric aerosol, are these small particles that are suspended in air. Here on the right, you have a size comparison of a typical human hair that's 70 micrometers in diameter, and then the blue spheres are PM10 10 micrometer in diameter particles. And the pink spheres are PM2.5, so 2.5 micrometers in diameter. And we are concerned about PM because it has adverse human health impacts.

And so we took measurements in basically two different modes. All of our instruments are on this vehicle, and so we drive around in the neighborhoods, taking measurements while driving around. And then we also took measurements while stationary at a home. So in this case, we park our instrument close to a home, which is the home of volunteers that were recruited by our collaborators at Harvard. And we basically take some measurements inside of the home and just outside of the home.

So, first, I'll show some early insights from our mobile measurements while driving around. So what you see here on the left and the right is the same satellite image of the Altadena area in the background. And on top of it, the colorful circles are our measurements. And so these are measurements on particulate matter and our measure our instrument provides data on composition. But for these graphs, I just added up all of the components. So this is just total PM1 mass in micrograms per meter cubed. These are the concentrations as we are driving around in this area. In this case, we are comparing concentrations in the afternoon and the evening of the same day. And one of the things I wanted to point out is that air quality and air pollutant levels are impacted by more than just emissions. So in this case, you can see impacts of just meteorology. And so the weather, basically, and the wind speed and direction, and boundary layer height that impact the levels of pollutants in the Altadena area.

Here are similar data that we collected in the Palisades. In this case, we didn't split it up by time of day. So this is just from one seven, eight hour drive in the Palisades area. And, overall, on average, we observed lower PM levels in the Palisades compared to Altadena. That is true in general before the fires also, and is in part due to just the location of Altadena being downwind of more urban sources. But we also observed quite a bit of variability of PM levels, so lower concentrations as well as higher concentrations in some other areas. And are continuing analysis to understand the sources of some of those higher concentrations.

And just to give a brief highlight of some of our measurements that we took inside of homes. So the way we did this is, in general, as we were driving through the neighborhood, again, we parked at one home for some time, took some measurements, indoors and outdoors, and then went on to the other home. So in this figure, I'm comparing three homes that we sampled on the same day, and they were different categories of proximity to the fires. And so house one was in the burn zone, but undamaged by the fires. House two was in the burn zone, damaged by the fires. And then house three was not in the burn zone. And what I'm plotting in this case is the total PM1 concentration in microcurrents per meter cubed. The open circles here are outdoor concentrations, filled circles are indoor concentrations.

So just to take you through these data real quick, we saw, in this first house that was in the burn zone, but undamaged, we saw higher PM levels outdoors than indoors. That's actually very typical for PM when there's no indoor sources. And so in this case, nobody was living at the house at that time. There was no indoor activity, no cooking, no cleaning. And so it's quite common that PM levels are higher outdoors because PM doesn't penetrate perfectly into the home.

Then we go onto this other house, and this is a house that was partially damaged during the fires, but here we observed higher PM levels indoors compared to outdoors. As well as, while we were taking measurements indoors, somebody turned on the HVAC system for the first time since the fires, and we saw a big increase in PM levels, due to turning on the HVAC system. So that's just to caution everyone that it's important to be mindful of the activities indoors, and to continue wearing protective equipment, especially when doing activity in a home that was damaged the first time after the fires.

And then the third house was our control. So still similar outdoor concentrations, lower indoor concentration in this case, as well as we could see the positive impact of reducing lower concentrations with the use of a particle filter indoors.

And so I'm going to plot this same data in a slightly different way to summarize it, and then compare it to gas-phase data too. So what I'm doing on the next graph is just to take ratios of indoor concentration divided by outdoor concentrations. So these are the same data again now plotted as a ratio inside particulate matter over outside and, again, showing lower concentrations inside and outside in the first house, undamaged. Higher concentrations in the damaged house. The impact of the HVAC system being turned on. And then lower concentrations in the house that was not in the burn zone, as well as the impact of the air filter.

So I have these same kinds of data also for one particular gas-phase component. So what I'm plotting here is the indoor outdoor ratio of furfural, which is one particular gas-phase component that happens to be a marker for biomass burning. And these are the same three houses, now measuring with this other instrument. And what we see here is that the VOC of the indoor to outdoor ratio for this gas-phase component is higher indoors than outdoors by about a factor of four for the houses in the burn zone. Now, it's actually quite common for VOC concentrations to be higher indoors and outdoors, and that's basically because you have the VOCs penetrating from outdoors, and also indoor sources of VOCs. And so here we see this again in the undamaged house. Then, in the damaged house, we see the impact of the HVAC filter. And then lower ratios in the house that was not in the burn zone.

And so just to briefly summarize this study and our future planned work is that we generally saw higher PM concentrations in Altadena compared to the Palisades. Our indoor measurements show higher concentrations in a damaged house in the burn zone. We are continuing to analyze this data that we collected in February of 2025. And, also, we will be taking new measurements later this month in Los Angeles to evaluate impacts of the cleanup efforts. And, yeah, I'd be happy to answer any of your questions, and just want to refer you again to the website to learn more about our study. I will want to thank all of my collaborators. Thank you.

Lori Dajose:

Yeah, thanks so much, Lea. I just had a quick follow-up question for your section is the impact of the HVAC system. So did the PM concentrations rise when the HVAC was turned on because it was circulating more in the air? It wasn't cleaning it up. The HVAC system isn't a filter, it doesn't act as a filter. Is that right?

Lea Hildebrandt Ruiz:

Yeah, right. So I suspect that the reason for the increases in concentration with the HVAC system was resuspension of particles that had been deposited in the house and in the HVAC system as well.

Lori Dajose:

Gotcha. So stirring it back up?

Lea Hildebrandt Ruiz:

Right, exactly, yeah.

Lori Dajose:

And then we just had one more question, which was, how far from the burn zone was the house that is considered not in the burn zone?

Lea Hildebrandt Ruiz:

I don't have an exact mileage on that, but it was in Santa Monica.

Lori Dajose:

Oh, okay, great. Thank you so much for clarifying that, and thank you for your presentation. So we'll turn now to our Caltech folks, Haroula and Sina from JPL. So, Haroula, people can learn more about your project called PHOENIX at the link that will be shared in the chat, I believe. So can you just tell us about what PHOENIX is, when it started, and what did you find?

Haroula Baliaka:

Okay, yeah. So, today, I'll be talking about PHOENIX, our project. Now, the objective of this project was that we wanted to create a dense air quality monitoring network, focused on measuring airborne dust and ash in and around the burned areas of Altadena, as a way of evaluating the ongoing dust mitigation activities. And, yeah, just going back to how it all started. Basically, in late January was when we discussed the scope of the project, and we realized by looking at this snapshot... This is a map of the PurpleAir low-cost sensors in Altadena. And you can see that most of the low-cost sensors that were reporting in Altadena were lost during the fire. And you can see this by the gap and the difference between the surrounding area. So there was definitely need for measurements, and especially for data related to the larger particles. Because the larger particles, as Lea said, are indicative of the local dust events, and especially as Altadena slowly recovers from the fire.

So why focus on these larger particles exactly is because they're heavily influenced by local nearby activity, and potentially with the cleanup activities, and truck traffic, as well as the dust resuspension. And by February 20th was when we received the first batch of sensors. And I'm just showing here the whole unboxing process. And then, three days later, we were able to deploy our first sensor. And I always love showing this little video of how we first started, and then we finally reached our goal a month later was to deploy 25 sensors. And this would not have happened if it weren't for Paul Wennberg, so my PI, and Colleen, who is a research staff scientist here at Caltech and an Altadena resident, very passionate about this project. And I'm showing here, well, me as well, I was part of it, I promise. And Nikos Kanakaris, who isn't part of the atmospheric chemistry group, but happens to be my husband, and was very helpful in installing the sensors.

And, yeah, this brings us to today, where we have 28 sensors. You notice we actually surpassed our goal because some residents bought them, and then we added them to the network as well.

And, yeah, I'll just briefly talk a little bit about our website. You can use this QR code. I know it's also going to be on the chat. If you've been with us from the beginning, you'll notice that we initially had this map, which shows the raw real-time data for PHOENIX. But as of today, shout out to Tom Morrell, we've updated it. We're still keeping the real-time raw data, but these maps are after data analysis and, hopefully, are going to be more informative. I'll talk a little bit about their style, what they represent, later on in the talk.

Yeah, so I'll just jump into some preliminary results. What I'm showing here is, each pie chart represents a PHOENIX sensor, and each wedge on the pie chart represents the fraction of number of days in each PM-10 category. And the color represents this PM10 category. And by looking at this, you'll notice that, from the moment these sensors started working, up until two days ago, overall, by looking at these 24-hour averages, we can see that we're within the good and moderate levels, based on these EPA limits and standards.

And if we dive deep into the minute to minute data, which our sensors do provide, what I'm showing here is a snapshot from April 10th. Now, each site represents two circles. So we have two circles, the outer circle is PM10, and the inner circle is PM2.5. And then the colors now represent the different limits that are shown here on the right. And I'll just play this little video. And what I want to emphasize with this, and I'll stop it here, is that there's a few things we notice. The first is that the PM2.5, so the inner circle, all of them almost remain in that green category. Whereas, PM10, we definitely see some changes in color, and even up to, if you notice, we reach the red category here. So this just goes to show you that while PM2.5 remained in the green category, we can see that we definitely have some dust events that potentially reach high concentrations for short periods of time. So we have small bursts of high concentrations that appear and then go away.

Now, if we zoom into one of the sensors that is on Fair Oaks, that is one of the main north to south avenues in Altadena, what I'm showing here is the Y-axis is time of day, the X-axis is date, and then the different colors, again, represent the different categories. And I'm only looking at PM10 now. So you'll see that there's this pattern here that emerges early morning.

And why might that be the case? Well, we have a few hypotheses. These are photos taken by Linda, by the way, who emailed them to me. And I actually told her that I would use them for the presentation. Is that, we potentially think that these dust events may occur in the morning when the trucks first arrive so we get resuspension of road dust. We also have the possibility of the road cleaners, sweepers, when they're cleaning up the road, as well as potentially being debris removal activities that are happening nearby the area. And we are doing further studies to potentially see what the reason might be behind these elevated concentrations.

Now, here, I'm showing the Y-axis is minutes per day. The X-axis, again, is date. Again, this is for one of the sensors on Fair Oaks. And then the different colors, again, represent this time I'm showing higher concentrations, so from the orange category up. And then the dotted lines just indicate the thirty-minute mark and the sixty-minute mark. And we can see that we definitely have activities where the higher concentrations are close to the thirty-minute mark. And then we have this one here closer to the sixty-minute mark. And what I want to do here is compare our results from the PHOENIX site to Pico Rivera in LA. So that's part of a different network called ASCENT. It's 14 miles south, basically, from Altadena. And, again, I'm comparing now same instruments, same time period. And we can see that the Altadena area may have had more dust events, compared to the ASCENT site.

But if we go back in time, so the ASCENT site has been operating since July 2023, so we have historical data to look at, and we can see that we definitely get dust events there as well. The difference is, though, that this dust, because we know the composition of it, we know is basically from crystal elements, mineral dust, basically, from the mountains. And, here, I'm just indicating that the first major rain event from this rain season was around this time. And we can see how these events slowly reduced.

And then I'll just jump into limitations. While it's great that we have a network of sensors, does our sensor tell us how toxic the aerosol is? Unfortunately, no. Our sensors only tell us how much mass there is, but not what the actual composition of that dust is, so what the particles are made of. But this gives a good segue to Sina's slides.

Sina Hasheminassab:

Thanks, Haroula. Yeah, so as Haroula mentioned, PHOENIX provides information about the total mass of particles, but it's important to know what those particles are made up of. So here at JPL, we have essentially equipped a subset of PHOENIX monitoring sites with additional equipment, in order to better understand some of the important components of airborne particles. So this map shows the location of the three sites that we have established, which include JPL campus, the Odyssey Charter School, and a site that we established right on the Woodbury Road. The reason that we wanted to do measurements on Woodbury Road was because it was designated as a debris haul route, and we have noticed a quite significant increase in truck traffic on that road. So we wanted to better understand the impact of increased traffic on local air pollution, especially on components of airborne particles.

The pictures on this map show the setup at each monitoring site. And I want to highlight that, even though at the school site you see our monitors are located inside a classroom, their sampling lines are actually routed through the windows so they're also measuring outdoor air quality. So each site is equipped with a number of monitors that measure a number of physical and chemical properties of airborne particles.

But in the next couple of slides, I'm going to focus on two important pollutants, namely black carbon and ultrafine particles, which are great tracers for traffic related air pollution. Starting with black carbon, or soot, it's an important component of airborne particles that's mainly emitted by incomplete combustion sources. And that's why it's a great tracer for traffic emission, especially from diesel trucks, which is quite relevant here. So the time series charts on this slide shows 15-minute average levels of black carbon at two of the three sites that we have, at the Woodbury and JPL sites. As you can see, clearly, the levels of black carbon are higher at the Woodbury site, compared to those measured at JPL, which is not really that surprising, given the large number of trucks traveling on Woodbury every day.

Now, if we take the average of these data, and look at these two sites side by side, we see that the levels on average at Woodbury are over two times higher than those measured at JPL. Unlike PM2.5 or PM10, we don't have standards for black carbon. So to put these numbers into context, I compared these levels with those measured concurrently at the Pico Rivera site, which is part of the ASCENT network that Haroula talked about. So the gray band in the background shows the range of black carbon measured during the same time at that site. Now, we clearly see that the levels of black carbon at JPL and Woodbury are within the ranges that are measured elsewhere in Los Angeles.

Next slide. Another important parameter that we are looking at are ultrafine particles. These are really tiny particles, generally less than 0.1 micrometers, so they're roughly 25 times smaller than PM2.5 that we've been talking about. In fact, they're so small that they do not have a lot of mass. And their levels are typically reported as number concentration, and that is the number of particles per cubic centimeter of air. And that's what's shown on the vertical axis on this time series chart. Ultrafine particles are mainly emitted by fresh combustion sources, and that's why they are also another useful tracer for traffic emission, but they can also be formed in the atmosphere through chemical reactions of various gases. The time series charts, again, shows 15-minute average values. This time, looking at Woodbury and the school site. Looking at the time series chart, we see generally comparable temporal trends of ultrafine particles between the two sites but, clearly, the levels seem to be slightly higher at Woodbury, compared to the school.

So if you look at the chart on the right-hand side, which shows the average values of ultrafine particles across the two sites, we can see that the levels at Woodbury are roughly 30% higher than those measured at this school site. Again, similar to black carbon, we don't have standards for ultrafine particles. But in the same way that, say, compared black carbon data to those measured at Pico Rivera, here, we are seeing the levels of ultrafine particles measured at that site. And, overall, we see that the levels of ultrafine particles at Woodbury and the school site are within the range of ultrafine particles measured elsewhere in Los Angeles.

So to wrap up my section with some takeaways, first, we clearly see that the levels of black carbon and ultrafine particles are elevated at the Woodbury site, which is not really that surprising, given the large number of truck traffic that we see there. But the more reassuring takeaway here is that the levels are noticeably lower at this school and JPL site, which are not really that far from the Woodbury site, which indicates that, as we get away from the busy road, the levels of these two pollutants drop quite substantially. Another thing, in terms of the levels at Woodbury, even though they're elevated, we still see that they're quite comparable to levels measured elsewhere in Los Angeles.

So one important component of particles that we have not yet looked into is metals and elements. So I'm going to turn it back to Haroula, who's going to talk about the next steps to look at that important component of particles.

Haroula Baliaka:

Yeah, thanks, Sina. So what's next? Well, we have collected dust samples on Fair Oaks, and you can see us over here. This is Colleen, and this is me. And lo and behold, there's a road sweeper. And what we're going to do is, these dust samples will be given to Francois Tissot's team. Hopefully, you might have heard of him from previous webinars. And this is Merritt. She picked up the samples yesterday. So, hopefully, we have some idea of what the dust is made of. And last, but not least, soon to be, we will be deploying an instrument that monitors real-time PM10 metals and elements as part of ASCENT. And we just received it, this huge box, crate, here has our instrument. So, hopefully, in the next few weeks, we'll have results from that as well.

Lori Dajose:

Thank you both so much. So just a few follow-up questions. Do you see spikes in the levels of the particulate matter when the wind is blowing with other meteorological events?

Haroula Baliaka:

Yeah, that's a really good question. And to Lea's point that meteorology does play a role, we do have meteorological stations at four of the sites. So as we improve and continue doing data analysis, we'll definitely be able to identify whether specific wind patterns intensify these activities as well. But, yeah, that's a really good point. And, definitely, wind does help with the resuspension of dust.

Lori Dajose:

Gotcha, thank you. And how does the PHOENIX data compare with the air monitoring data collected by the Southern California Air Quality Monitoring Project, SCAQMD?

Haroula Baliaka:

Yes, with the South Coast AQMD, so I haven't actually done any comparison. The only thing, and I've showed it with this presentation, is compared it with historical data from the ASCENT site and the data itself with the same period, which is in Pico Rivera. But, yes, there are three stations that South Coast AQMD hosts, so we definitely have a lot of data analysis ahead of us, so we'll definitely include that.

Lori Dajose:

Great, thank you so much, Haroula and Sina. So, now, we are going to turn to Rima. Rima, thank you for joining us to give the public health perspective. And we've received so many questions from the audience about whether it's safe to be in the area after the fire and during the cleanups. So we'll just jump right in. What do we know about the health effects of exposures to wildfires, and other metals and chemicals that the fires may have released?

Rima Habre:

First, thanks for having me. Thank you to Lori and the organizers. And thanks to everyone who gave us questions because we tried to organize this talk along those same questions that people are interested in learning about.

And so, Lori, back to your question, what do we know, and what don't we know? And I will say, in 10 minutes, I'm trying to be very brief, and give you the essential information that you need to know. But, basically, we know very well that wildfires, especially at the wildland-urban interface, emit smoke and ash that contain a lot of different contaminants, particles, gases, volatiles. And these can be concerning for health.

There's been many, many, many studies of wildfire smoke exposure and its health impacts, since at least the early 2000s. And that includes studying what we call near or fresh wildfire smoke, like at the time in LA when things were burning. That also includes older smoke, or transported smoke way downwind. And there's been a lot of work also on natural and climate-related disasters like wildfires, but floods, and hurricanes, and other things that have a lot of commonalities, in terms of their health impacts in these great events.

So we know there are acute or very quick health outcomes, and there are chronic health outcomes when people are exposed over long periods of time to these contaminants from these events. That includes respiratory outcomes like asthma worsening, COPD, cardiovascular outcomes, mental health trauma, PTSD, depression outcomes, cognitive outcomes, cancer in the long-term. These are things we know, and I'm not trying to underestimate the fact that there's still a lot to be done just in that space alone because we're trying to all improve the way we conduct these studies.

There's a lot of open questions still, but there hasn't been as many studies on what we call the cumulative impact of these multimedia types of exposure scenarios like what we're seeing, especially with the Eaton fires and the Palisades fires now. And so that means that the health impacts that we know exist from wildfires go beyond just the smoke. We're exposed to mixtures of different chemicals in air, from the ash that settles into water, and dust, and soil, et cetera. And we have to, basically, do more work to understand how all those things collectively impact our health.

The other thing that we don't know is that there's a lot of modern life materials, to be brief, these days, that have been emitted at probably greater concentrations than ever before. Not just EVs, and batteries, and solar panels, but also all the very complex things that are in our homes day to day. So that's also an open question, and why these specific events have maybe opened up more questions than we could answer right away. And, of course, there's concerns about lingering exposures and risks.

I did also want to give a huge thank you and shout out to Dr. Ruben Juarez and Alika Maunakea from the University of Hawaii because to prepare for your questions today, we wanted to look at what were similar events, and what did we learn from similar events. And the Maui wildfire events were really very similar in a lot of ways to the events we saw. And that includes how severe they were, how many structures were impacted, and some of the vulnerability factors that we worry about. So they were very kind to share with me, really on very short notice, some important links from their work. Please check out their community dashboard, where they're releasing data and visualizations on all these health screenings that they've done with more than 2,000 participants so far, and what they're starting to learn. And they were also very kind to share with me tidbits, or high level summaries, of what they are learning now in this phase.

So they are seeing clear evidence that social support really strongly moderates, or influences, mental health outcomes. And people with low social support had almost twice the risk of suicidal ideation and depression. And that, again, speaks to the importance of community, and all the great work that people are banding up to do on the ground together to support each other. They are seeing that exposure to lead, arsenic, these are metals that we worry about, and some of the volatiles, were more measurable in a subset of people, especially those that went back very early to the burn zone. And that's because they were more exposed to these things. We'll talk a little bit about what that means. And they're also seeing that access to care was uneven, and especially among immigrant populations in the case of Hawaii, but also people who don't have health insurance.

So, again, huge thank you to them because we wanted to share with you guys today what have we been learning from other events that could be similar. And they are also, very kindly, providing their time and advice to all of us doing this work at USC and in the LA Fire HEALTH Study.

So, Lori, if you don't mind, I'm going to continue through my talk, trying to address some of the questions you shared with me before. So even though these are very obvious, I wanted to just touch back on very fundamental exposure principles. Because I do think, if we remember what exposure is, in its very simplest terms, it helps us know how we can manage our own exposure. So you are seeing a lot of amazing measurement efforts, and the measurements give us an idea about levels of pollutants. But exposure is when people get in contact with these pollutants. And it depends on two things, to oversimplify it, concentration, how much, and time. So if you try to minimize that concentration by cleaning up debris, pollutants that are out there that we know are there, that's a good thing, that reduces people's exposures. And if you minimize the time you are there around these contaminants, that's also a great thing, it reduces your exposure.

And the data that Lea, and Haroula, and Sina showed, again, confirm that it's not that concentrations are elevated everywhere. Of course, there are local scenarios and sources that are still at play that are very important to consider, especially for those people very close by. But, again, it's always a function of how much, and how much time.

Exposure is also very personal contact. So if there's a high level of pollution somewhere else, if you are not getting in contact with it through what we call exposure routes, like breathing it in, like it getting on your skin, or babies putting their hands in their mouth when they're playing on the ground, that's not exposure. And I wanted to share this pretty amazing study that we worked on from the National Academies called Why Indoor Chemistry Matters. There's a specific chapter in there called Chapter Six that really breaks down what exposure routes are, and how, for different particles or volatile organics, or for different groups of people, different routes of exposure might be more important, so the way these things get into our bodies.

The last thing I want to say is, again, as a reassuring thing to me at least is, if there is no contact, there is no exposure, and then there is no risk. And risk really depends on, again, contact with the contaminant, but also how dangerous it is. And it's not that every single thing out there is equally dangerous. It just, again, goes back to the function of time, and what is that contaminant? There are very few things out there that if we're exposed to them for a few minutes, they're going to have a noticeable significant impact on our health. But, of course, there's a lot of nuance there and we're trying to understand more.

So, next, I wanted to give you a very quick overview of some of the work we've been doing, before even these fires, and then tell you more about work we're about to do in the LA Fire HEALTH Study, and at USC, and in various efforts with our partners and collaborators. So, very briefly, this is Roxana Khalili who's an amazing postdoc here in my team. We've been studying the effects of wildfire smoke exposure during pregnancy on birth outcomes for a while now. And we do see, and this is even before these fires, so up until about 2020 in our cohort, that pregnant women in LA actually experienced quite a few number of days of wildfires while they're pregnant, could even go up to seven months out of a pregnancy. And we see that exposure to wildfire smoke in the pregnancy period, and the preconception period, are associated with smaller babies in general, or lower growth of the infant. And that these effects are almost twice as high in what we call climate vulnerable neighborhoods. And so that's why it's also important to understand vulnerability and resilience of communities.

And I want to also mention that we're very excited that we just got another project launched with Dr. Shohreh Farzan, who's an incredible scientist and collaborator here at USC. We're extending a lot of this work to understand the effects of wildfire smoke and heat stress on children's cardiovascular health risk as they grow up.

We also just launched a Climate and Health Center here at USC. And without getting into too much detail, basically, the Center involves a collection of brilliant scientists here, who are working to advance the way we model wildfire smoke exposure, and also these other contaminants that came out of the fires that we recently experienced. We're also looking at vulnerability and adaptation to climate change, and to wildfire smoke exposure and heat. And how that impacts cardiovascular health across the life course. So I have a link to our website here, and we'll be sharing more. But, of course, we don't have too much time for details today.

But what have we been doing more specifically around the Eaton fires, and these recent fires, and with the LA Fire HEALTH Study? So as you heard from Lea, this is a big consortium that's being led by Dr. Kari Nadeau at Harvard School of Public Health, initially funded by the Spiegel Family Fund. And we're very fortunate to get to work with this brilliant team of scientists across multiple universities. It really is a big team. There's so much work going on that we cannot even begin to scratch the surface today. But please look at the website that Lea shared, and that we'll share again.

Dr. Nadeau and this consortium are supporting us in launching several different efforts. One of them, we actually are very excited that we just got a small seed pot of money to launch soon, hopefully, in the next month. That is the Eaton Fire Exposure and Health Community Study that I am leading with Dr. Shohreh Farzan, Megan Herting, and Jill Johnston at USC. We got, as I said, some support from USC, but also we have support from the LA Fire HEALTH Study Consortium. And this whole time we've been working on developing the methods and the protocols for how we want to assess different health outcomes in different groups. This specific Eaton Fire Study, we want to focus on the Altadena community and communities surrounding the Eaton fire specifically. We're going to start by targeting around 50 individuals to recruit in the study, including kids and older adults. And we're hoping to be in the field within the next month or so. But that is just what we're calling the first phase, with the hope of continuing that as a longitudinal follow-up over time.

So, very briefly, and this is the work of a large team of people that I will share next, what we're planning on doing is personal exposure monitoring, using silicone wristbands developed by Dr. Krystal Pollitt for exposomics. And I know the word exposomics is a bit new and might not be clear to everyone. We have some links at the end that if you're interested in learning more what that is, you're welcome to explore. But, basically, the idea is, with these devices that can be worn on the wrist, we can sample for thousands of different chemicals, and quantify them in different degrees of certainty, again, with the collaboration and support from Dr. Pollitt. We're also going to do some home-based air and dust sampling. And we're working with this amazing team of scientists that you saw present here today to do community, neighborhood scale, or very localized air monitoring. And to expand that into models of exposures for the community.

We're pairing that with a biospecimen kit, where we can basically collect bloods, and urine, and hair, and various biospecimens in a very simplified and packaged way, thanks to Dr. Kari Nadeau and her lab. So she is providing us support to, basically, use these methods that she has established, and also analyze these samples. And that will give us data on what people are exposed to inside their bodies, hopefully, very quickly that we can return back to people within a few weeks.

And then, finally, we're looking at cardiovascular, respiratory, neurocognitive, and sleep health outcomes to begin, again, in kids and adults. And we're hoping to expand on this effort in the future.

A huge shout-out to our amazing team. I mentioned Shohreh and Jill and Megan. We're working with Dr. Jeff Gold, who's also leading the mental health task force in the consortium, Dr. Krystal Pollitt, who's an incredible exposure scientist, and Dr. Elena Austin, who's also an incredible exposure and environmental health scientist. And she's been very kind with sharing a lot of her work, and her students' work, and protocols. And, of course, the LA Fire HEALTH Study team, the incredible Lisa Valencia, who's been working closely with Sina and colleagues to support the air monitoring work, and provide anything my lab can help with. And I do want to give a huge shout-out to Sina and Haroula, also, for leading this on-the-ground monitoring effort because it is a lot of work. It's very valuable and critical data that's being collected at the scale that matters, using newer methods and devices that are better capable of detecting these larger particles, like the QuantAQ sensors. And, again, huge shout-out also to Eben Cross and QuantAQ for their support.

We have not launched this study yet. We would love to hear from you if you are interested in participating, or have any advice for us. Please just send an email to our CLIMA Center email, listed here. And stay tuned on our website. We'll be announcing more concrete ways you can engage very soon over the next few weeks.

And I think I'm going to end by another question Lori had for me, which is, what can we share in terms of resources, or prior lessons learned from various similar or close to fires that have happened? And, again, from Maui, this is the initial report that came out with some of the data that Dr. Juarez shared with me, and they are going to be releasing more data soon. This is the Indoor Chemistry report and study from the National Academies that I mentioned. There are very brief highlights, if you'd like to read those. But, again, highly recommend Chapter Six. And then this great paper from Plumlee et al, from 2013 actually, goes into extreme detail about all the different contaminants, and exposures, and materials that are emitted by WUI types of fires, not just in air, but also as ash and into dust. So it's a really great read. I highly recommend it.

I'll wrap up with a few links. Hopefully, I didn't go too over. Our Climate Center, our Exposomics NEXUS Center, and the LA Fire HEALTH Study. Shout out to Eaton Fire Collaborative for great work that they're doing. And LADPH, of course. Thank you so much. These are our funding sources and ways to contact us. Lori?

Lori Dajose:

Thank you so much, Rima. Yeah, we did have a question in the chat about how can folks sign up to be involved in this exposure study. So I know you shared that information in your slides. Maybe one of our moderators can share that in the chat. So thank you so much to all our panelists. We have about 10 to 15 minutes for audience Q&A, so I'll try to get through as many as possible. And some of these, some of you have already addressed a little bit. So the first one is, when do you think air quality will return to pre-fire baseline levels? And I know Sina, and Haroula, and Rima, you may have touched on this already, but if you could just respond to that.

Haroula Baliaka:

I'll jump in first. And I think this is why all of us are doing what we're doing. We're trying to get to that question of when are we back to normal? And I think it's really helpful to have networks that already exist so that we can compare, as well as cross-comparison with the South Coast AQMD monitors as well. So I think we need to get down to what's in the dust that we're seeing and, hopefully, our future studies will get to that question and that answer.

Sina Hasheminassab:

Yeah, just to follow up on what Haroula has said, I just wanted to mention that, at the regional scale, the data clearly shows that almost immediately after the fires were put out, the air quality levels returned back to normal. At the local level, of course, given that a lot of activities that are happening there, as Haroula clearly showed, there are some short-term episodic events that could cause some high levels of air pollution. But, so far, based on the data that we are seeing, they seem to be limited to a few spots that a lot of cleanup activities are happening. And we don't have any evidence that these activities are impacting larger areas beyond the impacted areas.

Lori Dajose:

Gotcha. Thank you so much. That's really helpful clarification. So a related question is, how do wildfire pollutants behave after a rain event? And does rain fully remove airborne toxins, or can they resurface? So, Haroula, do want to take?

Haroula Baliaka:

Yeah, I'll go ahead and answer that too. So rain does really help with cleaning up the air. We've seen this repeatedly. And that is right, the reason that we are wetting the roads with the road sweepers, or they are using water when they're doing the debris removal, to help with dust not getting resuspended back into the atmosphere. But we do clearly see some of the local events despite the rain so, obviously, dust can still get resuspended.

Lori Dajose:

Thanks so much. And what is the efficacy of home air purifiers in removing these wildfire related pollutants, and which kind of air purifiers or technologies work best? And, Lea, I think I'll throw this one to you.

Lea Hildebrandt Ruiz:

Okay, great, yeah. So I would categorize the pollutants as particulate matter so that the aerosols and then the gas-phase pollutants, or VOCs. So for the particulate matter pollutants, the kind of filter I would recommend is a HEPA filter. So those are some of the most commonly used particle filters. And for gas-phase pollutants, I would recommend a filter that uses activated carbon that basically just uses adsorption so the gas-phase pollutants just get stuck on it. The efficacy will depend on the size of the device, and also for the VOCs, it will depend on what particular molecule it is. But, broadly, they are efficient. They can work very well. There are some really low-cost solutions for the PM filters, as well as the VOC filters as well. And that is something we highly recommend. It's something we've been working on quite a bit, especially since the COVID pandemic. It's how to clean up indoor air. Inside of your home, you have the ability to clean the air inside of your home. And so, if that is a concern, that is certainly something that you can do.

Lori Dajose:

Great, thank you so much. That's so helpful. All right, so next question is pretty specific. Do you see evidence of the activities happening at the Altadena Golf Course negatively affecting the quality of the air?

Haroula Baliaka:

We actually have some sensors nearby the Altadena Golf Course. And from what I've seen, personally, I haven't seen any significant dust events around that area.

Lori Dajose:

Thank you. It's good to know. All right, next question. Because the Air Quality Index doesn't tell the whole picture of the composition of what's in the air, how do we know when it's safe to go outside without an N95? Sina, do you want to take this one?

Sina Hasheminassab:

Sure, I can share some thoughts, but I also would like to pass it to Rima to share her opinion as well. So even with its limitations, AQI is still a great resource that can provide timely information about regional air quality. So, again, I still encourage everyone to consider using AirNow, as well as Southwest Air Quality Management District's map to get information about Air Quality Index. At the local level, any sensors that can provide information about the levels of pollutants in Altadena, particularly the PHOENIX network that has a very dense network of sensors, could be a very valuable resource to get more local information about pollution levels. But, also, at the personal level, people have to trust their common sense. Of course, if they're seeing any activities that they know emit pollutants, or could lead to resuspension of deposited dust and ash, those are the moments that they should take precautions, regardless of what the AQI says, or what the PHOENIX sensors report. But, Rima, anything else you want to add?

Rima Habre:

I completely agree with you, Sina, and thank you so much for that very clear explanation. I think you could still trust the AQI. Of course, we, as scientists, have all these things we would always love to improve with our monitoring technologies. And now we have things like QuantAQ sensors, and ETH labs, micro-aethalometers, things that are actually capable of seeing contaminants that we worry about, that the general regulatory monitoring network does not have. And that's for real reasons. It's not because people don't want to do that.

But I think the bottom line is, in general, look at the same information sources that Sina mentioned. If the AQI is good, it's generally good. LA, anyway, doesn't have the most amazing air. So there's been many days where the air quality is moderate to severe, even prior to the fires. But the most important situation to be aware of is, if you, yourself, are cleaning, or you're right next to a neighbor's home where they are cleaning and kicking up a lot of debris, or there's some remediation happening next to you, or you're right on those roads where the debris haul is happening, those are the special local situations where you need to be more careful. Hopefully, in general, if you live there, you close up your home. You do all the air filtration that Lea mentioned. And if you have to be outside for a long period of time, then it's not a bad idea to use an N95. But if you're doing any cleaning activities, or very close to these remediation activities, that's when it's really critical to use an N95 or, even better, a P100 if you're actively involved.

Lori Dajose:

Thank you for that clarification. I just had a question about the range of the sensors. So we have 28 different sensors in the Altadena area. And if you happen to be in between two of them, I guess, how localized of information does the sensor give you? If you're a little further from the sensor, can you still base your decisions, based on that data?

Haroula Baliaka:

Yeah, great point. So when we were planning this initially, the point we were going for was place the sensors about a kilometer apart. So you'll notice that we do have a good spatial distribution of the sensors. And what we've noticed is, for PM2.5, like how we mentioned already, it's more indicative of the regional background. So, I'd say, for PM2.5, the range can be much larger, but for PM10, it is very localized. So even when I was showing that little video of the PM10 and PM2.5 changing with time, you would notice that one sensor, for example, might be red, but then the other ones around were green. So for dust, and especially the larger particles, it's very localized. So it's almost just around that area just by a little bit.

Lori Dajose:

Gotcha. Thank you for clarifying. Okay, so just time for a couple more questions briefly. Is the N95 the right type of mask to be wearing to filter out all of these different sizes of particulate matter?

Rima Habre:

I don't know. Lea, if you'd like to add to this for. For PM, yes, but not for these other volatile organics. Lea, would you like to add anything to that?

Lea Hildebrandt Ruiz:

Yeah, I was just going to add that there are also masks that filter particles more efficiently. So there's a P100 mask. So depending on your level of exposure, so, for example, for workers directly involved in the cleanup effort, P100 masks are recommended. But then, if you want to protect yourself from the gas-phase pollutants, you would want a mask that also includes the filtration for the gas-phase. And, again, those would be activated carbon filters. I want to point out that, on our website, from the Fire HEALTH Study, as part of the data previews, we also have recommendations and information about the types of masks.

Lori Dajose:

Great. Thank you so much. All right, I think that's all the time we have for today. Sorry if we didn't get to your question. Thank you so much to our audience for joining us, and for submitting all of your great questions. Thank you to our panelists for your hard work in helping us understand the impacts of these fires. So a recording of this webinar, and all of the links in the chat, will be available on the Caltech Science Exchange, where you can go for more insights from researchers on fire-related topics. You can find that at scienceexchange.caltech.edu/fires. And all registrants will receive the recording of this webinar in your inbox when it's ready. So thank you so much to everyone, and we'll see you next time.