



CU On The Air Podcast

Natasha Stavros

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- Emily: Already in the U.S. this year, some 80 large fires have burned over 1.5 million acres in 12 states. More than 21,000 wildland firefighters and support personnel are on the front lines across the country. Today on CU on the Air, we're talking with CU Boulder Professor Natasha Stavros, a data and fire scientist and director of the Earth Lab Analytics Hub. We're discussing the effects of centuries of land mismanagement, technology in fire mitigation, and what it will take to preserve the land and save structures, wildlife and human lives.
- Emily: What's going on with our climate, other factors that that's perpetuating these mega fires that seem to be so prevalent today.
- Natasha So we emit fossil fuels and fossil fuels create this green house effect. And it's kind of like wearing a blanket where you trap the heat and it starts to warm up. And the longer you wear that blanket, the warmer it gets. Well, that's kind of what we've been doing since the industrial era began. And so the climate has been warming and there's this lag effect where it's going to keep getting warmer. And when we say that it's getting warmer, we're talking about the general average temperature globally. So as the coverage temperature gets warmer, we actually see climate change, which is changing climate in different areas. This leads into fire because that's the way that we've kind of thought about it in fire is there's this spectrum where you have flammability limited systems and that's something like the Pacific Northwest.
- Natasha You have a lot of fuel. But it's just not hot and dry. And so it doesn't really burn. And then you have on the other end of the spectrum fuel-limited systems, and that's kinda like Nevada, it's hot, it's dry, but there's not really anything to burn. And what you need for fire actually is completely different depending on where you are. So in a fuel-limited system, you actually have to have rain to carry fire because you have to grow the fuels through grasses. And then in these flammability limited systems where you have a lot of fuels, you actually need prolonged drought. And so as we warm up the climate, what we see is a move from these flammability limited systems to more fuel-limited. The problem is, is they're not actually fuel limited. They have fuel. That's one of the factors leading to really large.

Emily: These mega-fires, not only damage the states in which they take place, but far beyond, they have a huge impact. And how, for just one example of this is how far can smoke travel, and what is the impact of that?

Natasha Smoke can travel across continents across oceans. So last September was a really great example. We saw in all the headlines, you know, orange skies, in the west. And actually, if you looked at the satellite data, you could actually see those smoke plumes, carry all the way to the east coast, over the Atlantic, over into Europe. And the impacts, you know, really depend on how concentrated that smoke is. And they also depend on how vulnerable you as a person are. I'm a person who actually has a lot of sensitivity to smoke. So I have asthma, I have really bad allergies and I have an auto-immune deficiency. Like the trifecta. So for someone like me, it could lead to going to the emergency room, hospitalization, something like that. There are other people where it can actually lead to premature death. It's really hard to determine premature deaths, but on the order of thousands of people died prematurely because of last year smoke. Wow.

Emily: Just kind of going off on a slight tangent, but in your case, when the air quality is really bad because of these fires, what do you make sure to stay in doors?

Natasha So there's, there's kind of a lot you can do. I download the EPA Air Now app and I check that every morning I check the allergy web MD allergy app as well. I use this kind of as an indicator of like how much activity am I going to be doing outside? The other thing we could do is hardening your home. One of the things that you can do to harden your home is air purifiers. Uh, yes. Last year, actually, there was a huge shortage of air purifiers. Not only did we have distribution interruptions because of COVID and the factories were not there and the parts weren't there, but also everybody wanted to buy an air purifier. And so it's almost like they don't want to buy it until they have to. And at that point it's too late.

Emily: I'm one of those people, pretty much I do that with everyone's like, you should get an air purifier. Yeah, yeah, sure. I'll get one. Yeah. And I need one and I can't get, yeah.

Natasha It's the kind of thing where there's not a lot of incentives for people to increase the ventilation systems in their home. And the other thing is that a lot of the people who can't afford air purifiers can't go out and buy them. There are people who live downwind of some of the major fire events in public housing, in apartment buildings and they can't retrofit those buildings for themselves. And so this kind of gets into sort of inequitable impact that fires can have.

Emily: I wanted to ask you about this to kind of frame this discussion a little bit. Can you talk a little bit about the history of fires in the U.S. and some of the inequities involved?

Natasha Sure. And I'll start by saying that, you know, I'm not really the leading experts in this field, but you can't really be in this field without understanding a little something about it. So if you think back to when the United States was first colonized, the countries that colonized the United States actually did not burn. Britain doesn't really burn. Actually it's starting to burn. I think I saw a chart where were like, Hey, we have 25 acre fires, Big Wolf. So yeah. So when those people came over to the United States and they saw fires, they were afraid of them, especially when some of those fires were really destructive. They took an authoritative stance in the country. They took lands from tribal nations and tribal nations had actually been using fire for millennia. In fact, actually a recent study came out that showed that humans have been altering the landscape with fire for 92,000 years.

Natasha Wow. And there's other studies that have shown that humans are the way they are, because we could use fire to cook. Because we could cook food, we could eat more caloric and nutrient dense food that allowed our brains to evolve the way that they did and made us human. And so fire and humanity, they go hand in hand, shorter and tribal nations have been using fire to alter landscapes

around the world for millennia. But when you had the colonizers come over from Europe and they did not use fire in Britain, it was a scary thing. And so their reaction was suppressed fire. This led to centuries of fuel accumulation. And it wasn't until their scientists started to make the observations and keep records and say, look, our ecosystems are actually really unhealthy. If you had asked tribal nations, if that would have happened, they probably would have told.

Natasha But it's kind of like the little kid, you know, you can tell them the oven's hot, but they're not going to believe you until they put their hand on it. It wasn't until like the 1950s, when Western scientists started saying our ecosystems, aren't healthy, these ecosystems, they need fire. They don't regenerate without fire. They said, , great. But we don't know how to bring it back. And then in the late 1980s, there was the Yellowstone fire. Yep. This kind of reignited, a big fear of fire. And so even though we knew we wanted fire back on the landscape intellectually in practice, we didn't really know how to bring it back. And then in the nineties, we introduced air quality standards, which are fabulous. Like I, you know, as a person who's in the sensitive group who struggles with asthma and allergies and an auto-immune, I love air quality standard.

Natasha The challenges is that air quality standards actually placed this burden on people who prescribed fire to the landscape to help remove fuel. There's something to consider here, which is that prescribed fire. You can determine when you want to burn. And so based on when you burn, you can actually end up with different emissions. So ozone more prolific in summer fires because of the interactions with sunlight. Got it. And chemical interactions with sunlight. So if we were to burn in winter where there's less sun, you would get a different set of emissions, which could have different health impacts. But this is not considered in the current implementation of air quality standards and land management. Ah, and so you have some conflicts there yeah. In implementation. And so that's kind of where we are today. I don't really think that there's a lot of disagreement that we want fire back on the landscape. The disagreement comes to how do we do it? Got it. And how do we resolve that with other policies that we like that seem on paper to have conflicting objectives?

Emily: What's interesting is when you mentioned the Yellowstone fire, I worked in Yellowstone in 1992, uh, for the summer and saw these huge swaths of the park that had been burned. But you know, this beautiful life was regenerating. So when you mentioned that, that hit home. Well kind of in line with what we're talking about aside from policies, let's move on to technology. How is technology being used in fire detection and mitigation?

Natasha So the fire community is actually extremely tech savvy, and we use technology from risk mapping to situational awareness, to, uh, hazard planning and mitigation. Post-fire. So in all elements of fire, we will use technology. There's sort of observing technologies that give us situational awareness of it's getting hotter, it's getting dryer. You're more likely to have a fire. And actually one project that I worked on was developing an algorithm for the national interagency fire center. It's still TBD to be adopted, but the idea was to say, Hey, you have to plan. You have to hire people. You have to move resources around the country. You kind of want to know when you're going to need to hire people or is it going to be a really bad year? How many should you be hiring? There's like a forecasting component. What we did is we used hydrologic variables, measured from NASA satellites to develop an algorithm for forecasting. So that's one way that we can use technology in those sort of like forecasting realm. And then there's situational awareness. This is really, you know, where's the fire, how fast is it moving? How big are the flames? So this is something that actually a lot of people don't realize is that, you know, my mom asked me this question one time. She's like, why don't you just go measure the fire? I was like, I dunno, do you want to go stand next to a 150 foot flame? No, I don't even want to stand next to four-foot flame either.

Natasha We have satellites and drones and aircraft that are actually out collecting that kind of data of where the fire is. Now. The important thing is, and this is really where the state of the art is, is trying to contextualize that information with a bunch of other information that's relevant. Where are the

evacuation routes? Where are the access points? Where are the people, what kinds of people are they, are they elderly and on their internet? Are they connecting to social media or do we communicate with them by calling them on the phone? Or do we go knock on their door? . Like, so there's lots of questions about how do we contextualize this information to figure out how to keep people safe, ? And then there's sort of post-fire hazard mitigation. And so this is what we saw in Northern Colorado earlier, I think a week ago with flash flooding. When you have fire, it removes vegetation and it can burn through the root systems and this can actually make slopes very unstable. It can also lead to flash floods because water just slicks off the landscape and it doesn't actually absorb. There's nothing to catch it. And so those are the kinds of hazard mitigation. And that's where, using sort of observing technologies, we can map with it what the situation is sort of at a larger scale than we could actually walk out on the landscape and figure it out. Yeah, that's good.

Emily: Well, we don't want you walking out on the landscape and figuring it out.

Emily: Can you just tell us a little bit about your background and how you became a data and fire scientist?

Natasha Sure. I'm from San Diego, California, and I think that's a really important part of the story. In 2007 there was a really major fire in San Diego. And that was the first time that my family was evacuated. And this was actually like a terrifying event because I love my mom and she loves her things. And so the idea of having to leave home and leave all those things, it was just this very like traumatic experience. And, then I didn't really think much of it. I was always pretty good at math. And so I went off to college actually at CU Boulder for my undergrad. I did math and computer science kind of a twisty turny road. Um, I actually started out as a business major and I was like, Ugh, no, I don't want to do this.

Natasha But that business background is actually really important. I think on some of the things that we talk about when we talk about technology and data science and where we're going with that. And then I got an internship at laboratory of atmosphere and space physics, and I was like, who cares about the sun? Um, where's the sun going? You know? And so I was like, well, what do I care about? And I cared about, you know, plants and nature and trees. And so I went and did a master's in environmental sustainability in Scotland, which is where I really learned about the intersection of people, economics and the environment, and kind of how those, those three things work together. And then I was looking for a PhD and there was a program out of Washington and they said, well, you know, how do you feel about big fire events and air quality?

Natasha And I was like, well, I'm from San Diego and we were evacuated. And one of my childhood friends lost his home and we had smoke weeks where we couldn't go to school because the smoke was so bad. And I was like, I guess I'll study that. And they said, great. And I had no idea what I was signing myself up for because studying extreme fire events is actually really hard to do because none of the statistics work, uh, you know, because you're not in the normal part of the distribution, you're dealing with a very small sample size of extreme events. And so I was the first person to really try and actually develop some statistical models for how climate would affect large fire events. Wow. From that year forward, it's just been more and more fires. And it's really strange to look back now and say how I defined an extreme fire event then is actually not as extreme today because our fire sizes have just gotten bigger. Huge.

Emily: One of the innovations you've developed something called the WKID Innovation Framework as the basis of WKID, WKID being an acronym for wisdom, know, information and data. And I love this tagline 'solving wicked problems through innovation as a process, not a product.' Can you tell us a little bit more about this and how does the framework work and how is it slide?

Natasha I actually developed WKID Innovation from my time working at NASA for seven years as a system engineer. And working in the arena of extreme fire events and data and mathematics, and actually

having a little bit of a business background. Like even though it was only, I think a semester or two in college sort of speak business. I get approached a lot about like, oh, I have this great new technology. I have this great thing. And, and constantly I saw people trying to push a product. But in working with NASA, I saw how true innovation actually really happens. Like groundbreaking innovation that happens over long periods of time. NASA invests in technology that is just so at the cutting edge that we don't even anticipate it, which is why actually NASA was the first company or organization to come out with a ventilator, a mass print, open licensed ventilator after COVID pandemic started, well, why were they able to do that? I was looking at how NASA innovated and I realized that there was this breakdown in how people were trying to come up with solutions and how you actually come up with solutions that get adopted and have longevity. It kind of maps to this knowledge hierarchy. The best computer in the world is the human brain we process. We processed data in the form of photons and photons instantaneously. As I'm talking to you, you're actually nodding your head. That's an action. But that action is informed by you knowing that I'm telling you something of value, information that resonates with you in the form of data, photons and photons, as you listen and watch me. But your brain is doing that instantaneously. And so WKID Innovation is based on this idea that our informed actions are wisdom. That's really where we're using the breadth of our experience to make the best decision that we can. Sometimes we don't have all that we need. That's really where the technology comes in because we know what decisions we need to make. Using this kind of framework, we're able to define technologies that can change people's behavior by sort of systematically understanding and evaluating where are the real gaps and that's what NASA does, and they do it very systematically.

Emily: The melding of your business with the science is a very useful, and I think a lot of people would benefit from that. One of your roles is director of the University of Colorado Boulder's Earth Lab Analytics Hub. Can you tell us about the work happening there? And some examples of projects you're working on at CU Boulder.

Natasha The Earth Lab is dedicated to using earth observations to study global environmental change and earth observations come in many forms. They come through satellite imagery, drones. Um, they also come through social media and all of this is actually quite big data. It's how do you work with that big data? And so within earth lab, there's the analytics hub and that's really about the analytics and the data science behind working with that big data. And so that's really what my role is. As we, we enter into a world that's in so much flux and we want to actually harness all of this data, how do we do it in a meaningful way? And another dimension of what we do is saying that there is no way that one person could do it all or, or pioneer all the ideas. And so we actually invest a lot of time and energy into thinking about open science, which is the philosophy that we are all better together. If we are all, all empowered to contribute to the body of knowledge, rather than a single person who has the vision. And we all just follow that vision. I love that. We think about big data, global environmental change and how to enable as many people to contribute as well.

Emily: That's wonderful, especially, increasingly it's incredibly necessary. That's very cool.

Natasha [21:52](#) It's an amazing team. I've just been so honored to join this team because it's just a lot of really great thinkers who are really at the cutting edge. And it's also a women led team. Oh, nice. Which is, is very cutting edge. Yes. So we really live and embody what it is that we're trying to create in the world.

Emily: [22:16](#) That's wonderful. Oh, that sounds like a very rewarding, satisfying job if I may say so. You and your colleagues recently brought some of the top fire technology innovators together with fire managers, politicians, and academics to brainstorm solutions to wildfire problems. Can you tell us a little bit about this when this meeting happened and, and any potential solutions that resulted?

Natasha [22:41](#) In 2019, California, governor Gavin Newsome hosted a fire tech work summit. And this was after the campfire that killed 85 people. And of course, Silicon valley came out. The industry went from like a few dozen people to hundreds overnight. And it was just amazing to see how many people had solutions for something they didn't actually understand. Back in 2019, I had this dream like, let's host a workshop. Let's, let's get the people who've been in the field for a long time who really have been trying to work on this to define what the real problems are. And I was kind of told, no, we're not going to do that for awhile. Well, earlier this year I was approached saying, let's host the workshop. So March of this year we hosted this workshop and we invited a lot of the big leaders and people who had a lot of momentum behind what they were creating.

Natasha [23:39](#) So it wasn't just like, I thought of a solution in my garage, but like, I've been doing it for a while or I have lot of money or have a lot of backing, or I have a lot of social support, behind what I'm doing. I was very clear with all of the participants. It's great to know what your solution is, and we all want to hear what your solution is so that we're not reinventing, but the real point of this is to hear what are your challenges? Yeah. Why is it not moving forward? The whole workshop was about trying to define the common challenges that we were all met with. Sort of saying, you know, we're all coming up with really great ideas and, and why aren't we making progress? . Because we all want to help.

Natasha [24:22](#) Fire's this amazing bipartisan issue that every single human being it's like, no, we don't want to kill people. We don't want houses to burn, you know? No, one's no one's competing with that idea. So like, why aren't we making progress? And so that was the point of the workshop. And basically what we came up with was that there were sort of four major barriers and solutions. I'm going to focus on kind of what the solutions were great. So one of them was actually that we needed a national strategy, that there were so many people, all with different pots of money and slightly different objectives and agendas. And if you were to give a dollar to each person and they were to go into the store, they can get a Hershey chocolate bar.

Natasha [25:11](#) But if you were to put your money together, you can go get like the nicest chocolate.. So that was kind of what we were seeing across federal agencies was that each agency was given money and they were building their own initiatives, but those initiatives didn't necessarily work together. And so this kind of creates barriers to technology adoption, to consistent policies and, you know, sort of competing asks of the, of the federal government. The idea was, you know, let's get a national strategy and outline roles and responsibilities and outline how we're going to work together. And who's going to be responsible for what another area that we talked about was a need for sustained access to observations. Now we have a lot of observations. We actually have more observations than people realize through cameras, through Twitter, through NASA satellites, NOAA satellites, commercial satellites, even classified assets.

Natasha [26:09](#) So this kind of gets into questions you had about Fireguard. So we have a lot of this data. The thing is, is that we don't really want data. We want information to make decisions in real time. And so in order to go from data to information that can inform actions to knowledge, to wisdom, we need to open access because we need more people working on this than a few limited minds who are, you know, thinking of specific solutions to each problem, because there's so many problems, there's so many ways to use the data. Yeah. And so we don't have open sustained access to that data. So that was kind of another big challenge was that, and the data that we do have the all income in inconsistent formats. So you just spend all your time trying to clean the data, not even using it.

Natasha [26:56](#) And then the third arena was having to do with sort of funding and specifically private sector, recognizing that private sector can play a major role. And in fact wants to play a major role. Like as evidenced by that fire tech summit by California, governor Gavin Newsome, they want to show up, they want to be there. They want to contribute. But the role that they can have in providing a public service is very unclear. And not only is it unclear, we don't understand the true costs of fire. And so there's, it's virtually impossible to create a sustainable business model. So even if they wanted to

come to the game out of the goodness of their hearts, . They can only come for so long before there has to be something to continue the incentive. And we can't go that next step because we don't understand the true costs of the services that they're providing.

Natasha [27:46](#) And who would be paying that? Because fire is actually managed by many small local governments. There's federal agencies that manage, but like the land management agencies, aren't the same as the tech and agencies like NASA. And then finally we talked about making a shift away from framing of suppression to thinking about resilience and what is fire resilience? What is fire resilience? So fire resilience is this idea that you know, fire's going to be on the landscape and it's a really essential part. We want it to be there. We also don't want it to have all the negative consequences. So how can we live in harmony with fire? Got it. And still be resilient to fire being there. And so that includes lots of different things. And I think you had asked some questions about sort of, what can we do in resilience planning and infrastructure.

Natasha [28:52](#) I've kind of thought of this in four different sort of sectors of infrastructure, if you will. So there's resilience from the perspective of energy, there's energy distribution. I think 2020 Cal fire released a report that said that 10 out of 20 of their biggest fire events were actually power line related. Well, . How we transport energy from one place to another really effects, fire and fire danger and an accidental fire, you know, fires that we don't want at the wrong time, . In the wrong places. We need to rethink about power distribution and my solution. And again, it's just, my solution is networked micro grids. That rely on renewable energy. That's local to the area. So if your area has a lot of sun, let's use solar. If it has a lot of wind, let's use wind. If it, if you're next to the ocean, you have tides let's use tides.

Natasha [29:47](#) Yes. You know, the reason why I say networked micro grids is because even though we want micro grid, so we don't have to transport energy, vast distances, you still have incidents. Like what happened in Texas earlier this year. Where we do still want there to be backups? Sure. We need to rethink how we provide energy to people. And the advantage to actually think about network micro grids with renewable energy is that also helps with climate change mitigation because it reduces the amount of carbon emissions that we have. Another sector is in development and urbanization. The things that we can think about there are, you know, building codes and zoning. So we actually, for a very long time had flood zones across the country. You can't build there, or you can build there and we're not going to insure you.

Natasha [30:38](#) But we don't have fire zoning. And part of that's because we're just starting to, and actually this is something that earth lab has worked on. Virginia Iglesias, within earth lab just released a paper called risky development, where she was looking at natural hazards and how they're changing and where we're building our homes and how we're doing that. We've only just started to do that and have the science and the data to be able to produce these maps. So the next step is going from that to zoning, that affects city planning. It affects insurance, and re-insurance also building codes. So this includes things like air purifiers. It includes things like ember guards on gutters. And not building porches out of wood. Because dried wood is more flammable and you really don't want that burning next to your house for too long.

Natasha [31:30](#) The third area of infrastructure is roads. There has been a lot of discussion by Congress about this infrastructure, bill and roads. One of the things the United States does very well is having a road network. Well, we need to think about our roads and how we're going to upgrade that infrastructure because this affects evacuation routes going in and out of places and congestion. The fourth sector in infrastructure is natural resources in that area. We're thinking about timber, clean water. So we need to start thinking about, you know, ecosystem resilience to fire and how that affects water quality. And we need to think about how we're affecting air quality. This is where prescribed burning comes in and forest management and the importance of that. And they're absolutely essential to the infrastructure bill as far as I know.

Emily: [32:23](#) Yeah, absolutely. This is fantastic. I think we could probably do like a four-part series on this podcast, but what can our listeners do in their own lives to support the environment, fire mitigation efforts?

Natasha [32:40](#) I think the first thing that they can do is they can talk to their neighbors about what they're learning about fire. We suffer from sort of the archetype that fire is bad. And the more we can understand that fire is actually an essential part of humanity, it's an essential part of the Earth system, we can start reframing it and then people can start thinking about resilience and that kind of leads to. So then what can we do for resilience in our own lives? Well, you can work on home hardening, even if it takes you a while to get there, just investing in ember guards on your gutters.

Natasha [33:20](#) Or buying an air purifier, whenever the opportunity comes up and you have a little extra cash, get the air purifier, you will need it. And then there's talking with your family about what your evacuation plans are. So have a list. What are the core things that if you had five minutes, what do you need to grab? You know, do you have a go-bag um. You have animals. Do you have enough food for them? Do you have a place to go? Yep. Do you know, three to four evacuation routes to get out in case there's congestion. And is there a local notification system that you could sign up for? So these are just like, just plan. Just know that it may come up and you want to be ready for it. Absolutely. And the last thing is if there's a fire in your area my advice is not to wait until they ask you to evacuate. Yeah. Because that's when you have the most congested roads, firefighters have to spend time getting you out instead of working on the fire. If you have a place to go, if you have a means to be able to leave, just leave, grab a tent, go somewhere. Go stay with a friend. There's really not a reason to stay. And a lot of people wait until they have to leave, but we don't have to.

Emily: [34:34](#) Very good advice. Thank you. Is there anything else you want to tell our listeners? I mean, there's so much, you could tell our listeners, so it's hard to put a button on it.

Natasha [34:42](#) The only thing I would say is just that what we experienced in 2020 is it's not the future it's today and it's going to keep happening thinking I don't have to think about it. I dodged the bullet this time, you know, luck only happens so often. And so you want to be prepared.

Emily: [35:01](#) Thank you so much for your time today.

Natasha [35:03](#) Well, thanks for having me. It's really fun.