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Urban Air Quality Modeling: Evaluating Impacts of Ecoroofs on Urban Air Quality in Portland, Oregon

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WEBVTT

1

00:00:28.980 --> 00:00:38.640

Danlyn Brennan: Hello and welcome to our podcast. This is doing a tank and I'm here with my partner damelin Brennan. Hello, you were here to tell you the story about our project for the altar, you

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00:00:38.880 --> 00:00:49.290

Danlyn Brennan: Which stands for alternative Research Experience for Undergraduates. This was a unique eight weeks long project based program, led by PA, Dr. Koh stuffed toy shirt.

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00:00:49.860 --> 00:00:53.280

Danlyn Brennan: Professor from the Department of Electrical and Computer Engineering

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00:00:54.000 --> 00:01:04.710

Danlyn Brennan: Along with Mackenzie gray program coordinator and soon to be PhD candidate in biology and quality education research goes from Portland State University.

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00:01:05.550 --> 00:01:13.680

Danlyn Brennan: Thanks to both of you for making this a fun way to learn remotely engage with other like minded students and play a role in bettering society.

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00:01:14.760 --> 00:01:28.950

Danlyn Brennan: The focus on this program is to give students like us an opportunity to dive into competition on modeling by taking ownership of our projects at the same time, we would serve the local community by building modeling tools to answer some challenging questions.

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00:01:30.180 --> 00:01:33.780

Danlyn Brennan: So, so we know what school are you at, and what are you studying them.

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00:01:35.220 --> 00:01:45.600

Danlyn Brennan: I am a rising junior studying Mechanical Engineering at the University of Washington and I'm a rising senior setting by medical physics and chemistry at Portland State University.

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00:01:46.260 --> 00:01:53.100

Danlyn Brennan: Of course, our team wouldn't have gotten as far as we have as an eight week period. We've got help from our mentors and academia and industry.

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00:01:53.520 --> 00:02:03.630

Danlyn Brennan: We were able to interview some of the mentors who helped us along our journey. They had a lot to share about why they do what they do and how the impact of this kind of research is important to them.

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00:02:05.010 --> 00:02:06.060

Danlyn Brennan: So they've been thinking

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00:02:07.980 --> 00:02:13.800

Danlyn Brennan: Particles have been positive reviews and how roofs and Premier plants can help.

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00:02:17.160 --> 00:02:17.490

Danlyn Brennan: Sounds

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00:02:18.960 --> 00:02:26.100

Danlyn Brennan: Like I can't moving the quintessential that's Dr. Sorry. Our research mentor, leaving the Eco roof air quality.

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00:02:28.020 --> 00:02:29.610

Danlyn Brennan: Sure, good afternoon. My name is an

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00:02:30.810 --> 00:02:42.480

Danlyn Brennan: Associate Professor in the Honors College and University. We also work with David Evans and ML manager from Google who helped us with the coding and implementation side of the project.

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00:02:44.490 --> 00:02:58.170

Danlyn Brennan: My name is David Evans. I am an engineering manager at Google. I work primarily with AI and ML for conversations in the Android messages product.

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00:02:58.860 --> 00:03:14.400

Danlyn Brennan: For your role in the green room researchers well on this project is part of a collaborative effort between myself and the Honors College. I'd rather than stealing the biology department and

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00:03:15.150 --> 00:03:28.380

Danlyn Brennan: Elliot call in during our men can have on premise. Um, it's an interdisciplinary project that is trying to investigate how equals your quality to color.

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00:03:30.030 --> 00:03:35.850

Danlyn Brennan: Indoors including with indoor and now this work that you're doing kind of expand it a little bit.

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00:03:37.050 --> 00:03:37.800

Danlyn Brennan: Cleaner tomatoes.

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00:03:40.650 --> 00:03:50.250

Danlyn Brennan: Okay. So the title of our project is urban air quality modeling evaluating impacts of eco roofs on urban air quality in Portland, Oregon.

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00:03:51.510 --> 00:04:00.060

Danlyn Brennan: damelin this project has actually been your passion for a couple of years now. Can you set the stage for us and talk about why this research question is so important.

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00:04:00.840 --> 00:04:09.330

Danlyn Brennan: Well, I've been working as a research assistant for a few years now, with an interdisciplinary group of colleges biologists chemists engineers.

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00:04:09.690 --> 00:04:19.620

Danlyn Brennan: To investigate the reality of the plants in urban spaces specifically dreamers, or peoplecall me Grover's which hosts a variety of organisms mainly

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00:04:20.790 --> 00:04:32.550

Danlyn Brennan: Our research group has been measuring emissions from those plants found on typical greener, we hope to discover some interesting findings that can help guide current and future research and sustainable environmental engineering

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00:04:34.770 --> 00:04:35.190

Danlyn Brennan: Research

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00:04:37.110 --> 00:04:45.840

Danlyn Brennan: Yeah, I mean, I'm really excited about this project because we know very little about how plants sector quality generally and

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00:04:50.760 --> 00:04:54.300

Danlyn Brennan: Chance to think about health specifically green plants.

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00:04:56.160 --> 00:05:14.820

Danlyn Brennan: As you're aware, I have a large part of my we're caring about equal groups and their, their role in managing storm water and so reading green infrastructure and city. So this is a new and exciting direction for research and then I'm really happy.

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00:05:16.260 --> 00:05:31.080

Danlyn Brennan: To say inability is a word we hear a lot about anything so many different things to different people. I like to think it's safe to say like collectively as a whole society we want to live in healthy environments that can be challenging in urban spaces for a number of reasons.

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00:05:32.490 --> 00:05:37.500

Danlyn Brennan: as climate change, Dr temperature up an ultimate ecosystems further this loose.

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00:05:38.610 --> 00:05:50.130

Danlyn Brennan: We have to make critical decisions about how we build our future environment, the best adapted to time for stimulation of this scale that can assist in

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00:05:51.990 --> 00:06:07.200

Danlyn Brennan: Modifying quality of life, potentially for people who live in an area I think is really important because we don't you know these things happen on sort of human lifetime right as it stands. So right now, our best way of understanding

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00:06:08.220 --> 00:06:09.000

Danlyn Brennan: The way that these

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00:06:10.050 --> 00:06:20.340

Danlyn Brennan: affect people is to sort of look at people who have lived under

particular conditions for long periods of time. And to sort of see if there was any effect there. In this case, we can take what we currently know

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00:06:21.480 --> 00:06:30.540

Danlyn Brennan: And sort of simulate that and extrapolate out those things and then that really helps urban planning and people who are coming up with how to

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00:06:31.230 --> 00:06:40.380

Danlyn Brennan: Design these spaces for the people who live there. It really helps them kind of figure out what are good decisions of what are potentially bad decisions.

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00:06:40.890 --> 00:06:47.760

Danlyn Brennan: Without having to wait two years just to see if you know everybody's helped me or even kind of project that out based on will be already know.

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00:06:49.440 --> 00:07:01.680

Danlyn Brennan: Allow more than other these decisions about being infrastructure investment needs to be investigated so that we as a community and optimize the healthy urban spaces and environmental equity within our cities.

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00:07:03.960 --> 00:07:17.160

Danlyn Brennan: Previous studies suggest that not all species of plants are created equal. In such that certain species may decrease air quality due to their emission of biogenic volatile organic compounds BBC

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00:07:19.500 --> 00:07:32.490

Danlyn Brennan: You have any thoughts about how our specific project meaning like the symbol one dimensional model to investigate the air quality impacts the biogenic volatile organic compounds that are emitted.

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00:07:33.780 --> 00:07:36.360

Danlyn Brennan: How does that fill the gap in the current research.

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00:07:38.160 --> 00:07:41.280

Danlyn Brennan: The research that's been done to learn. We looked at how they

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00:07:42.720 --> 00:07:46.110

Danlyn Brennan: How airplanes and particulates air pollution.

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00:07:47.340 --> 00:08:00.690

Danlyn Brennan: deposited onto the green plants, but we know less and less about how plants can actually do style tiles and what that means for not only outerwear quality, but also kind of

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00:08:01.320 --> 00:08:11.970

Danlyn Brennan: What I said earlier indoor air quality service plans are often situated right next to the country. And so we really need to have a better understanding of what that area is

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00:08:17.760 --> 00:08:24.270

Danlyn Brennan: The design and the organization of urban environments is guided by people decision makers like city planners.

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00:08:24.810 --> 00:08:36.210

Danlyn Brennan: And now, more than ever, these decisions about green infrastructure investments need to be well investigated so that we as a community can optimize the healthy urban spaces and environmental equity within our building.

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00:08:37.200 --> 00:08:48.690

Danlyn Brennan: And, you know, I'm still very new to study at the college and environmental engineering, but to me. This project has been a major eye opener about the air quality challenges in my home city of Portland.

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00:08:49.380 --> 00:09:03.300

Danlyn Brennan: And what assumptions we need to start challenging about best ways to combat urban pollution and it's allowed me to start taking my engineering background and see how I can apply that to make a positive impact through designing green infrastructure.

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00:09:04.380 --> 00:09:15.900

Danlyn Brennan: I'm at the stage where I'm choosing what sector if mechanical engineering. I want to specialize in and working on this topic has given me more clarity about the ways I can contribute to sustainability as the engineer.

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00:09:18.870 --> 00:09:25.860

Danlyn Brennan: Like the world of the algorithms. Right, so like the computer science and the spectrum. And there you know

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00:09:27.720 --> 00:09:37.770

Danlyn Brennan: The physical world, the real world. I'll say is very is very truly analog and that everything is a curve right there are no clock cycles.

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00:09:39.060 --> 00:09:41.340

Danlyn Brennan: Out in the world. And I think that like the

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00:09:42.540 --> 00:09:55.920

Danlyn Brennan: The thing about fusing the disciplines together is really to bring that translation for life. Right, like a computer simulation will literally never be more accurate than the real world. We all know that.

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00:09:56.940 --> 00:09:58.770

Danlyn Brennan: And I think that the tolerance for that.

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00:10:00.060 --> 00:10:06.660

Danlyn Brennan: The tolerance for that difference is much higher on the computer science side, right, because we're, we're, we're sort of talking about

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00:10:07.620 --> 00:10:17.580

Danlyn Brennan: errors that are really small. And I know that it's it's a little harder on the physical sciences side because those errors. Add up as you scale back up. Right.

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00:10:18.990 --> 00:10:20.550

Danlyn Brennan: And I think that like those

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00:10:21.810 --> 00:10:27.720

Danlyn Brennan: Needing the disciplines together is really the best way to say like, okay, instead of

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00:10:28.890 --> 00:10:29.640

Danlyn Brennan: Instead of sort of

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00:10:31.020 --> 00:10:44.160

Danlyn Brennan: Trying to imagine a set of experiments to run right and just setting them up and hoping to get them all put together and then hoping on the other end of those of those experiments that you're getting data then

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00:10:45.390 --> 00:10:49.080

Danlyn Brennan: Either confirmed or denied your hypothesis or that you're getting data at all.

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00:10:50.370 --> 00:10:54.330

Danlyn Brennan: The idea. I think that putting these things together is to take

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00:10:55.770 --> 00:10:58.530

Danlyn Brennan: I think it's really good to take all of the understanding that you have

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00:10:59.070 --> 00:11:08.910

Danlyn Brennan: And sort of create a fake world read it and create a fake email servers and see like test your understanding under the big conditions as much as possible.

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00:11:09.360 --> 00:11:19.620

Danlyn Brennan: Because that might help you actually design better real world experiments better real world data gathering and really identify areas where like the data that that are available.

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00:11:20.490 --> 00:11:28.740

Danlyn Brennan: is weaker than you might have thought, right, because under simulation, you find out that like it's effect seems to be much smaller and you need to really like

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00:11:29.700 --> 00:11:32.790

Danlyn Brennan: Instead of going out and planting a million or

71

00:11:33.630 --> 00:11:44.400

Danlyn Brennan: Whatever is in order to like increase the emissions rate of some be VOC you could just go into sort of like if they stimulate the growth and really just crank it up as if every last surface of the planet.

72

00:11:45.270 --> 00:11:53.370

Danlyn Brennan: Is some type of BBC emitter and see what happens. Even from the ballpark and then try to understand if there's a missing piece to do that without

73

00:11:54.360 --> 00:12:05.460

Danlyn Brennan: Without having to go out into the field without having to have, like, you know, an abandoned building look at or a field to grow a specific type of thing in you could really narrow down what you're looking for.

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00:12:06.780 --> 00:12:08.910

Danlyn Brennan: On a much, much shorter time scale.

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00:12:10.110 --> 00:12:13.800

Danlyn Brennan: Just by sort of like modeling out your math modeling out environment.

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00:12:16.680 --> 00:12:24.690

Danlyn Brennan: Currently very sophisticated models and expensive software, just to model chemical interactions and dispersion throughout an urban environment.

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00:12:25.620 --> 00:12:30.750

Danlyn Brennan: So how would a simple one be model compared to those and could have been used to help make these kinds of events.

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00:12:31.710 --> 00:12:48.630

Danlyn Brennan: And the other thing that I really enjoy about your project is that it is applicable at different scales. Right. So a lot of the to working on is, I think, starting with something very simple scale. But I think that, you know, especially because we know that

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00:12:49.770 --> 00:12:50.460

Danlyn Brennan: Adopted

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00:12:51.540 --> 00:12:54.300

Danlyn Brennan: Agreement basically a requirement as part of this.

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00:12:55.590 --> 00:13:03.600

Danlyn Brennan: Plan and we know that we're going to see more and more reduce in the downtown area and you're working on this. I understand.

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00:13:07.920 --> 00:13:15.000

Danlyn Brennan: So computational modeling is what I like to think of as mass of work

now. Not that serves

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00:13:16.140 --> 00:13:21.300

Danlyn Brennan: Me. That's the best part of that Selena, how would you describe your thoughts and computational modeling.

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00:13:22.680 --> 00:13:36.030

Danlyn Brennan: You know, saying how you know you completely understand something. If you can teach it to someone else. There's this computer science, you have one which says you really understand something. If you can teach it to a computer.

85

00:13:37.320 --> 00:13:44.970

Danlyn Brennan: So the journey towards making a function of model is kind of this mechanism to really learn about on begging and understand it well.

86

00:13:45.510 --> 00:13:50.280

Danlyn Brennan: And then apply that to exploring the scenario sweet runs, and I think that's really useful.

87

00:13:51.180 --> 00:13:56.970

Danlyn Brennan: Using experimentally determine fluxes of BBC from the different greener species.

88

00:13:57.450 --> 00:14:07.320

Danlyn Brennan: We hope to build a simple tool for planners and engineers to use to help with decision making process when it comes to choosing the appropriate plant species for the green infrastructure project.

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00:14:08.100 --> 00:14:15.900

Danlyn Brennan: So the journey towards making a functional model is kind of this mechanism to really learn about a topic and understand it well.

90

00:14:16.470 --> 00:14:29.910

Danlyn Brennan: And then apply that to exploring the scenario as we want. And I think that's really useful. So with these tools we can simulate the potential impacts and introducing green infrastructure and look at these overlooked parameters such as

91

00:14:31.050 --> 00:14:35.010

Danlyn Brennan: To see if they really do impact air quality in the way that we would expect.

92

00:14:38.340 --> 00:14:56.070

Danlyn Brennan: This is what I really like another thing that I really like about this project is that it does two things right sort of advances are theoretical understanding of all plants or what health plans that are quality while so addressing supply concern. Right. So how, what is installing

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00:14:57.300 --> 00:15:08.370

Danlyn Brennan: And you're going to be, you know, not only are these data that we have. So very unique and valuable, but you'll be using the model to kind of understand this very

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00:15:15.090 --> 00:15:27.810

Danlyn Brennan: Well, neither of us are computer science majors and building up a computational model from scratch is no small task. This is why we needed some expert guidance to the technical details of building that algorithmic framework.

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00:15:28.980 --> 00:15:45.180

Danlyn Brennan: Went out areas where like we can grab some efficiency here, we might want to structure this this way, you know, let's let's always look at one second, because, you know, then this this variable can disappear because it's always one. So it's been kind of neat have to work so closely.

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00:15:48.450 --> 00:15:54.570

Danlyn Brennan: To address the need for an easy to use accessible tool to analyze the effect of green roofs on air quality.

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00:15:55.110 --> 00:16:04.470

Danlyn Brennan: We created a simple mathematical modeling simulating the transport emissions in a wonky space with partial differential equations and their numerical solutions.

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00:16:05.370 --> 00:16:14.550

Danlyn Brennan: One dimensional means we analyze the urban space that we chose I was theory, the volume down on top of each other like it's our

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00:16:17.130 --> 00:16:27.540

Danlyn Brennan: The complex interactions between the many parameters we plan to

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build into the simulation include microclimate data like wind speed, direction competitor analysis.

100

00:16:29.220 --> 00:16:36.570

Danlyn Brennan: Solar radiation data because some of the chemical reactions occur in the presence of sunlight. Sorry, but

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00:16:38.940 --> 00:16:39.390

Danlyn Brennan: I'm good.

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00:16:40.860 --> 00:16:52.740

Danlyn Brennan: emission rates from traffic as a percentage sources and by authentic sources from the green room deposition for the settling of particulate matter onto rep services for me.

103

00:16:54.270 --> 00:17:02.820

Danlyn Brennan: So we hope to develop a tool that offers enough complexity to be comparable to the outputs that you'll see in the sophisticated model.

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00:17:03.270 --> 00:17:19.140

Danlyn Brennan: But also simple enough in terms of the user ability. It doesn't work that way. It's the models are tools to help you understand how well you understand the thing that you understand

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00:17:20.370 --> 00:17:28.440

Danlyn Brennan: Like it's there to tell you, like, here is how far off of reality right if you have come up with

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00:17:29.730 --> 00:17:41.040

Danlyn Brennan: A set of equations that that that come close to approximating the real world interactions of things and you run those through model at a really high scale you see them.

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00:17:42.300 --> 00:17:46.290

Danlyn Brennan: Blown up to scales that you couldn't possibly directly measure

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00:17:47.580 --> 00:17:57.930

Danlyn Brennan: And you notice that something's not quite right then, like, that's the, that's the model saying like I you know I did what you said. And I'm not sure

if it's right.

109

00:17:59.370 --> 00:18:12.750

Danlyn Brennan: And it's a and the model is actually not even the one telling you that the model saying like, you told me to do x i did X and then you as a human, you, you are the expert, you look at it and you say, Who this doesn't look quite right.

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00:18:14.010 --> 00:18:16.230

Danlyn Brennan: Or it looks great and it's surprising.

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00:18:18.150 --> 00:18:26.610

Danlyn Brennan: But those the model is a tool just to make it so that you know your understanding of the physical world can be accelerated.

112

00:18:28.620 --> 00:18:41.820

Danlyn Brennan: So with these tools we can simulate the potential impacts of introducing green infrastructure and looked at these overlooked parameters such as plant emissions to see if they really do impact air quality in the way that we would expect.

113

00:18:42.690 --> 00:18:49.830

Danlyn Brennan: What might that expectation be well it's complicated, and it's not all good news, to be honest. Why is that

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00:18:51.000 --> 00:19:00.480

Danlyn Brennan: So each plant has its own signature and mission. If you want to think about it that way. It's a mix of all the different chemical species that are coming out of the plant.

115

00:19:01.590 --> 00:19:02.700

Danlyn Brennan: So kind of like a person.

116

00:19:03.780 --> 00:19:22.440

Danlyn Brennan: Yeah, like. We all smell different for the most part, right. We all emit a cloud of chemical soup that is unique to your hygiene products that we use sense that we enjoy food that we eat, it's the same for plants oil in most materials.

117

00:19:23.640 --> 00:19:33.900

Danlyn Brennan: Of course, some plants are stickier. As I like to think about it than others. And we all know and have experience when we stop to smell the roses, or enjoying the aroma well

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00:19:36.120 --> 00:19:44.130

Danlyn Brennan: All of those chemicals are really plugging in the air and when certain chemicals interact with each other. They can form a larger articles.

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00:19:45.000 --> 00:19:56.700

Danlyn Brennan: Some of those he called particulate matter or specifically PM 2.5 or PM 10 because those are especially problematic when it comes to human health intend to track those

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00:19:57.480 --> 00:20:17.520

Danlyn Brennan: A lot of research is done looking at concentrations of those two sizes of particulate matter. And then there's other harmful species that are a product of the reactions of these chemicals like oh these chemicals are so dangerous like the EPA regulations in place to limit you and

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00:20:18.960 --> 00:20:32.970

Danlyn Brennan: So that's why it's important to track potential exposures with the best of intentions, it's still possible to create more of these harmful chemicals when we bring in certain species of plants that provide the ingredients for worse conditions and just traffic condition.

122

00:20:35.640 --> 00:20:48.990

Danlyn Brennan: Actually studying up on this a little bit last night. Right. So people have made inventories of the kinds of types of volatiles that different plants are producing. But a lot of these inventories. Do not include second plants.

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00:20:49.500 --> 00:21:00.330

Danlyn Brennan: And so being able to couple here and model was an experimental data on all types spy succulence is can be really valuable theoretically

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00:21:01.770 --> 00:21:09.720

Danlyn Brennan: So there are a lot of sophisticated models out there that simulate mass transfer and chemical reactions like Megan and Andy men.

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00:21:10.230 --> 00:21:19.530

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Danlyn Brennan: And they all have really steep learning curves and paywalls that exclusivity limits access to academics royalty companies and organizations.

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00:21:20.070 --> 00:21:34.620

Danlyn Brennan: So more tools are needed to make decisions based on the most current science and the easier those tools are to use and access the more we can all contribute to the quality of building healthy and sustainable urban environment. So this will benefit you or the Portland resident

127

00:21:36.930 --> 00:21:37.800

Danlyn Brennan: That's a good question.

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00:21:38.970 --> 00:21:48.210

Danlyn Brennan: You know, you have no choice residents have no choice about the air that they take in right you just are subjected to what they they give you

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00:21:48.930 --> 00:22:08.100

Danlyn Brennan: What is given what is in your environment. And that has a huge hostess patients. And so for me, as a Portland resident this work and its contribution to understanding there that we read central management implications makes me think about what this work is doing for my health.

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00:22:09.390 --> 00:22:16.950

Danlyn Brennan: More research is needed to investigate these questions by a simulation of the spaces that are most vulnerable to public health disparities.

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00:22:17.730 --> 00:22:35.430

Danlyn Brennan: A brand new publication in the journal Science shows that there's been an overall improvement in air quality over the past 36 years yet, there remains demographic disparity where the most polluted areas continue to be the most polluted in terms of PM 2.5 concentrations

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00:22:36.510 --> 00:22:47.730

Danlyn Brennan: That predominantly affects the health and quality of life for low socio economic status communities, which also disproportionately affects minorities immigrants and people of color.

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00:22:48.780 --> 00:23:03.210

Danlyn Brennan: These populations are more vulnerable to negative health outcomes related to environmental pollution and that's also reflected in disproportionate

numbers of cases of respiratory disease and susceptibility to the current, current a virus pandemic.

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00:23:04.500 --> 00:23:12.390

Danlyn Brennan: With more tools available to more people. We can investigate the application of these technologies, which is equal routes to improve our quality.

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00:23:13.110 --> 00:23:24.120

Danlyn Brennan: And we should be taking a look at the most extreme living conditions within our society to important environmental equity and planning and investment about the variety of plants in our

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00:23:25.170 --> 00:23:40.860

Danlyn Brennan: Different rates vice, you know, we don't know why, but some plans and then more or less ice cream here to others as we get those data. This model is going to help us understand then which plants, you might want to select

137

00:23:42.420 --> 00:24:00.480

Danlyn Brennan: Like you have this power down to really see how the world reacts to extreme conditions, all because all because the large and the very small have been modeled into A into a much more accurate representation of the real world. So, but people are great too. I mean, clean air rules.

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00:24:02.010 --> 00:24:02.610

Danlyn Brennan: Go clean

139

00:24:03.660 --> 00:24:04.710

Danlyn Brennan: Go healthy people.

140

00:24:06.810 --> 00:24:09.090

Danlyn Brennan: As well, everybody liked it when

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00:24:10.410 --> 00:24:12.780

Danlyn Brennan: When the buildings. Don't look gross all the time.

142

00:24:13.860 --> 00:24:21.540

Danlyn Brennan: From being disgustingly filthy and I'm from the rust belt. So, you know, I grew up in an area with portable air.

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00:24:23.370 --> 00:24:27.600

Danlyn Brennan: So it might be bad for inhaler manufacturers through them.

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00:24:29.970 --> 00:24:31.950

Danlyn Brennan: I don't know. Is that good. Was that a good answer. I

145

00:24:36.600 --> 00:24:46.830

Danlyn Brennan: Wanted to thank all of the other materials that helped us along the way. Dr. Elliot call Dr. Todd Rosenstiel for deep REM Subramanian and Dr. Christopher

146

00:24:48.300 --> 00:24:53.790

Danlyn Brennan: Thank you for answering all our questions and contributing to our learning class during this alternative, are you