WEBVTT

1
00:00:00.000 --> 00:00:01.600
Nefa Grant

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00:00:01.740 --> 00:00:09.240
Laurie Anderson: and I run Mifa with an excellent set of code leaders. So this is not a

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00:00:09.310 --> 00:00:17.949
Laurie Anderson: a single effort. But we have members of our network management team and our network advisory team who have joined us.

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00:00:18.030 --> 00:00:22.750
Laurie Anderson: And we're very excited that the rest of you are here as well.

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00:00:23.190 --> 00:00:36.809
Laurie Anderson: I'll just remind you of a couple of zoom etiquette items. We ask that you keep your your self muted unless you're speaking.

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00:00:36.900 --> 00:00:45.180
Laurie Anderson: That can help matters also. If you feel you need close captioning, you can turn it on yourself.

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00:00:45.240 --> 00:00:53.319
Laurie Anderson: You can look at the little 3 dots where it says more at the bottom and activate the closed captioning.

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00:00:53.350 --> 00:01:03.090
Laurie Anderson: So you're welcome to do that, if you'd like. and I'll just remind you again that we're following the Erin code of conduct.

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00:01:03.570 --> 00:01:15.160
Laurie Anderson: And when we get to the question and answer session, I would like to suggest that people type that into the chat that tends to work well for zoom management.

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00:01:15.750 --> 00:01:33.109

Laurie Anderson: So we'll use the chat when we do that. Also, just to give you kind of an overview and remind you about the schedule. Our plan is to I'm just going to give a little brief introduction to our network and what we're trying to accomplish here.

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00:01:33.120 --> 00:01:38.400
Laurie Anderson: and then I'll introduce our speaker for today. Dr. Tamara harms

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00:01:38.640 --> 00:02:05.350
Laurie Anderson: dr. Harms will speak for about 30 min, then we'll have a chance for QA. With her, and then I'd really like to encourage you to stay for about a 20 min session of breakout rooms, because we'd really like this event to build community across a large geographic area. So Zoom is really the way to do that often most conveniently.

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00:02:05.410 --> 00:02:09.659
Laurie Anderson: But we will make sure that the event ends promptly at 5 15.

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00:02:09.710 --> 00:02:22.899
Laurie Anderson: So that's the plan for the event. So without further ado, I'm going to go into my slideshow mode here.

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00:02:23.710 --> 00:02:26.750
Laurie Anderson: So let me do that

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00:02:30.990 --> 00:02:38.149
Laurie Anderson: and talk a little bit about the macro systems, ecology for all network

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00:02:38.970 --> 00:02:41.759
Laurie Anderson: and invite you all to get involved.

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00:02:41.990 --> 00:02:58.469
Laurie Anderson: So the Mefan network supports faculty from all backgrounds in developing collaborative macro systems, ecology projects for research and teaching with a focus on diversity, equity, inclusion and justice.

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00:02:58.650 --> 00:03:10.940

Laurie Anderson: And we're a spin-off of the ecological research. And as education network or Erin, that's a group that I've been involved in a leadership role for a long time along with many collaborators.

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00:03:11.030 --> 00:03:19.089
And we really wanted to get more into macro systems. Ecology. As that particular discipline grew.

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00:03:19.340 --> 00:03:31.830
Laurie Anderson: So we have a grant from the National Science Foundation to run Mifa from 2022, through 2027, so there'll be some time for you to engage with us.

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00:03:32.620 --> 00:03:37.069
Laurie Anderson: and let me just make sure I can. Yes, move right along.

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00:03:37.660 --> 00:03:47.250
Laurie Anderson: So what is macro systems? Ecology? Well, actually, our speaker today will hopefully give us a great example of macro systems research.

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00:03:47.350 --> 00:04:00.690
Laurie Anderson: But just quickly. Macro systems. Ecology is defined as the study of diverse ecological phenomena at the scale of regions to continents and their interactions with phenomena at other scales.

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00:04:00.710 --> 00:04:05.939
Laurie Anderson: And I love this example from the Heffernan paper of the Amazon rainforest

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00:04:06.030 --> 00:04:13.610
Laurie Anderson: that really showcases these interactions across scales where a global demand for beef

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00:04:13.690 --> 00:04:18.269
Laurie Anderson: is driving the clearing of tropical rainforest for pasture.

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00:04:18.350 --> 00:04:30.450
Laurie Anderson: This basically changes the competition dynamics

between tree and grass and creates a patchwork of different vegetation across the landscape

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00:04:30.570 --> 00:04:33.629
Laurie Anderson: that can have strong effects on regional climate.

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00:04:33.810 --> 00:04:44.000
Laurie Anderson: And these multiple scales are interacting to produce, you know, a real change in rainfall and fire dynamics across the Amazon.

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00:04:44.550 --> 00:04:57.909
Laurie Anderson: So we're hoping that within our group, we can, you know, really be thinking at these multiple scales and thinking about these interactions in a I guess in a more intentional way, perhaps, than we have in the past.

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00:04:58.970 --> 00:05:12.120
Laurie Anderson: The goals of our network are to expand faculty training in macro systems, ecology as well as some of the tools of macro systems, ecology, data, science, existing environmental data sets.

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00:05:12.440 --> 00:05:29.959
Laurie Anderson: Our second goal is to really have a focus on diversity, equity, inclusion and justice, especially in the way that we collaborate with each other as we do this research, and be accessible and inclusive for scientists and students from all backgrounds.

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00:05:29.990 --> 00:05:43.889
Laurie Anderson: because we also have a focus on teaching faculty faculty who are mainly in teaching roles at their institutions, although we welcome faculty, who are doing any kind of work.

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00:05:44.530 --> 00:05:53.480
Laurie Anderson: We also want to enable collaborative macro systems, research and support the development of projects and use that as kind of our model for training.

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00:05:53.490 --> 00:06:02.679
Laurie Anderson: We'd like these projects to contribute to science,

but also be de Ij centered and address macro systems, concepts.

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00:06:03.220 --> 00:06:18.479
Laurie Anderson: And finally, we want to educate undergraduates through these projects. As I said, we focus on teaching oriented faculty. And so we want this research to really be meaningful for undergraduate participation.

38
00:06:20.210 --> 00:06:48.490
Laurie Anderson: And we're gonna start right now. So we've invited Dr. Tamara harms to join us because we think she has some great examples of macro systems research that we can think about. And this can kind of stimulate our discussion in the breakout rooms about how we can transform our own work into something that is more focused on on macro systems ecology.

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00:06:49.020 --> 00:06:52.740
Laurie Anderson: So I will escape from my slideshow

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00:06:53.050 --> 00:06:56.610
Laurie Anderson: and stop my sharing for a moment

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00:06:57.190 --> 00:07:03.030
Laurie Anderson: and introduce. Dr. Harms, let me.

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00:07:04.220 --> 00:07:05.480
Laurie Anderson: let me

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00:07:06.780 --> 00:07:11.600
Laurie Anderson: tell you a little bit about her to get us started.

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00:07:15.680 --> 00:07:20.539
Laurie Anderson: So Dr. Tamara Harms is at the University of California at Riverside.

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00:07:20.630 --> 00:07:31.879
Laurie Anderson: She is an ecosystem ecologist and biogeochemist, interested in the effects of spatial heterogeneity and hydrologic flow paths on elemental cycles.

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00:07:32.270 --> 00:07:39.800
Laurie Anderson: She has studied desert riparian zones and streams, urban ecosystems and boreal and arctic catchments.

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00:07:39.980 --> 00:07:51.089
Laurie Anderson: Current foci include biogeochemical indicators of ecosystem resilience. responses of carbon, nitrogen and phosphorous cycles to permafrost thaw

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00:07:51.180 --> 00:07:56.170
Laurie Anderson: and influences of fire and hydrologic regimes on desert streams.

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00:07:56.600 --> 00:07:59.309
Laurie Anderson: So let's welcome Dr. Harms.

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00:08:01.180 --> 00:08:05.310
Tamara Harms: Thanks. Laurie. is the sound. Okay? Coming from my end.

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00:08:05.520 --> 00:08:15.899
Tamara Harms: We can hear you. Great. It sounds good. Okay, great. Thanks so much for inviting me. I'm on a tiny screen so I can't see your faces. I can only see my slides while I present

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00:08:15.900 --> 00:08:38.790
Tamara Harms: but thanks. So much for the invitation to to present to this group. I was funded in in the first round of the Macro Systems biology program from Nsf and contributed to that Heffernan and all paper. I thought, developing those ideas were really exciting. And

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00:08:38.830 --> 00:08:43.049
Tamara Harms: have continued to think about how my work

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00:08:43.260 --> 00:09:10.049
Tamara Harms: informs and helps develop concept central to macro systems ecology. So it was fun to put this this talk together and and and link up some elements of my research program to specific concepts in macro system. So I'm gonna I'm gonna keep to time today. And I'm gonna present 3 different examples of macro systems for my work.

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00:09:10.210 --> 00:09:36.460

Tamara Harms: But just to give you a general sense of what I'm interested in I'm an ecosystem ecologist and a bike chemist. I primarily study cycles of carbon nitrogen, phosphorus and I typically use a catchment perspective increasingly, I use sensor networks measuring chemistry and streams at high frequency. And then I apply statistical methods for analyzing time series to extract signals from those data.

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00:09:38.330 --> 00:09:52.879
Tamara Harms: So let's see if I can move to next slide. Yeah, okay, so here, here's that familiar diagram from the Heffernan and all paper. And I know that many of you have read this, and you pro. You've discussed it as part of one of your camera. I'm sorry to interrupt, but this slide did not shift for us.

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00:09:53.100 --> 00:09:57.150
Tamara Harms: It did not shift for you. What about?

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00:10:01.150 --> 00:10:01.880
Laurie Anderson: So we

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00:10:02.170 --> 00:10:07.580
Laurie Anderson: oh, now we're not. Now we're off this green chair. I know I'm going to try again.

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00:10:07.830 --> 00:10:11.599
Tamara Harms: let me try again.

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00:10:29.350 --> 00:10:31.640
Tamara Harms: Okay. now, if I

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00:10:31.920 --> 00:10:38.790
Tamara Harms: now we see that figure from a Heffernan at all.

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00:10:39.300 --> 00:10:42.539
Tamara Harms: do you get? Do you get text, propping up on the slide. Now.

64
00:10:42.910 --> 00:10:44.740
Laurie Anderson: unfortunately, we don't.

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00:10:45.630 --> 00:10:48.669
Tamara Harms: We see the figure? But we don't see your text.

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00:10:49.590 --> 00:10:53.110
Tamara Harms: Okay, let me

67
00:10:55.910 --> 00:10:58.290
Tamara Harms: because it is pausing.

68
00:11:00.500 --> 00:11:03.760
Tamara Harms: Okay, let me let me try something else.

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00:11:12.310 --> 00:11:15.200
Laurie Anderson: Technical excitement of Zenum.

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00:11:55.250 --> 00:11:57.169
Tamara Harms: Okay, let's see if this works.

71
00:11:57.520 --> 00:12:21.020
Tamara Harms: Now, do you see text coming up? Yes, it's working now great. Always use. Pdf, that is the lesson of zoom. Okay, so so I know that you've all have have read, or most of you probably read. And this. This paper's been out for a long time. It's old news, but I was using it as a guide. To to get us on the same page and point out the

72
00:12:21.480 --> 00:12:22.710
the

73
00:12:23.320 --> 00:12:36.180
Tamara Harms: the concepts and phenomena that are definitive of macro systems, biology that we want to learn about. And the the reason why nsf began moving funding in this direction. So

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00:12:36.180 --> 00:12:58.339
Tamara Harms: macro systems as Laurie defined our study of patterns and phenomena that occur regional to continental scales. And there are interactions that that bring those phenomena about and the important interactions that we're interested in learning about our teleconnection. So these are connections between ecological or biological phenomena at very distant parts of the world.

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00:12:58.340 --> 00:13:15.730
Tamara Harms: I'm not gonna give an example of these today from my work. But an example that that impinges on some of my work is that fires can generate ash that contains nutrients like phosphorus that can cause phytoplankton blooms in the oceans or in aquatic ecosystems. Very distant to where the fire happened.

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00:13:17.230 --> 00:13:33.180
Tamara Harms: How can I get this to work? Now, there we go. Okay? So the second interaction is macro scale or cross scale feedback. So these are feedbacks that occur either at the macro scale or between smaller scales and the regional or continental scales.

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00:13:33.270 --> 00:13:43.849
Tamara Harms: And and I'll give an example of a potential feedback that we discovered that involves continental scale gradients in primary production and streams and the influence of climate warming.

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00:13:45.250 --> 00:14:07.909
Tamara Harms: There are also cross scale interactions that don't generate feedbacks that just didn't involve interactions between processes or OP patterns on a local scale and patterns at the macro scale. And I'll give 2 examples of these cross scale interactions. One, that involves disturbance and climate influence on stream chemistry

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00:14:08.010 --> 00:14:09.970
Tamara Harms: and

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00:14:10.320 --> 00:14:27.150
Tamara Harms: another that involves influence of fire on stream chemistry and erid lens. And then, finally, we're interested in identifying and understanding emergence. That arises at from cross scale interactions. So this is where

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00:14:27.190 --> 00:14:39.990
Tamara Harms: lots of small scale processes or accumulation at small scales, generate phenomena that that are observable at the macro scale, or or emerge at the macro scale.

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00:14:40.190 --> 00:14:58.920

Tamara Harms: And there's you can think of lots and lots of examples involving decisions about land use where there's individual decisions being made on small scales, on parcels of land that in some total generate larger scale phenomenon, such as changes in air, quality, or water quality.

83
00:14:59.850 --> 00:15:16.449
Tamara Harms: And then and then the features of of macro systems that we recognize to be important in bringing these interactions about our bio complexity or links across levels of of biological organization. This is things like soil biodiversity influencing patterns in net, primary productivity.

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00:15:16.910 --> 00:15:40.849
Tamara Harms: both spatial and temporal heterogeneity and then connectivity between those those heterogeneous patches. I'm not gonna have time to talk about this examples from my work about this today. But I'm very interested in in the role of spatial heterogeneity and and how connectivity arises. I've done lots of work thinking about how perma frost influences, hydrologic connectivity of landscapes.

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00:15:41.550 --> 00:16:05.749
Tamara Harms: Features of macro systems include slow variables. These are the very variables that change very slowly over time, but can have outsized influence on ecological processes. In in my research, this is largely involved thinking about changes in permafrost and and soil, organic matter stocks where these things change really slowly.

86
00:16:05.750 --> 00:16:12.119
Tamara Harms: but because they influence so many processes. When they do change, they they can catalyze an array of

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00:16:12.120 --> 00:16:15.389
Tamara Harms: ecological surprises, and then, finally.

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00:16:15.390 --> 00:16:29.479
Tamara Harms: it is impossible to think about larger scales without thinking about how humans and human behavior have have influenced ecological processes. So macro systems, biology must incorporate thinking about humans as components of ecosystems.

89
00:16:30.530 --> 00:16:45.410
Tamara Harms: Okay, so first example is of cross scale interactions.

I'm gonna show 2 examples about this. The first is, how many streams do we have to monitor, and how frequently, if we wanna drive meaning from those data.

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00:16:45.650 --> 00:16:53.320
Tamara Harms: I'm gonna make use of data sets from from some iconic catchment monitoring sites in in the North temperate zone.

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00:16:53.490 --> 00:17:11.350
Tamara Harms: And then the second example of cross scale interactions is in our work, determining the effects of fire on aired lens and specifically on aquatic chemistry in Airedland catchments where we're testing a conceptual model using a data synthesis at a large scale.

92
00:17:11.790 --> 00:17:29.920
Tamara Harms: Okay? So first, how many streams do we need to monitor there've been monitoring of of headwater, stream chemistry and discharge many of these programs have were established in the sixties and seventies, and they've continued until now.

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00:17:29.920 --> 00:17:41.939
Tamara Harms: And the idea behind those catchment monitoring programs was to understand something about hydrology and about how disturbance influenced

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00:17:41.940 --> 00:18:03.580
Tamara Harms: ecosystem processes. So we're using stream chemistry as an integrative signal of ecosystem response to press and pulse disturbances. But but funding for these programs, these rooms require a lot of funding. They're expensive to maintain, and funding has has been pulled for some of these programs, including some of the data sets that we have analyzed here.

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00:18:03.810 --> 00:18:33.039
Tamara Harms: So to understand how many catchments we need to observe or monitor to be able to say something about how dur disturbance influences ecosystems. We analyze long-term records from those observatories from 1,984 to 2220, and we worked on the the sites shown in black. Here we considered the sites shown in white, but they their their data records didn't meet our our standards not in terms of data quality, but amount of gaps in length.

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00:18:34.120 --> 00:19:03.699

Tamara Harms: So we ended up with 22 headwater catchments that were monitored in as part of several different observatories. We're gonna analyze flow weighted mean concentrations. And and to analyze those time series, we're using a statistical approach called multivariate auto-aggressive state space models or Mars models. And to estimate a long term trend. So are these catchments exhibiting trends in response to changing climate and changes in atmospheric deposition.

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00:19:04.240 --> 00:19:28.900
Tamara Harms: We're also monitoring seasonality is there? Are there common patterns, and how chemistry is responding to seasonal changes. And then what's important about state space models is that they separate process error, the natural processes that are generating temporal patterns in the data from observation error, our ability to accurately observe those processes.

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00:19:30.190 --> 00:19:40.029
Tamara Harms: Okay? So we we asked at what spatial scale are temporal patterns in stream chemistry coherent.

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00:19:40.090 --> 00:19:56.140
Tamara Harms: and we might expect that that coherence could emerge at at any of several different spatial scales. So we considered whether, yeah, each catchment was unique, and there is a distinct temporal pattern at each head. Water catchment, including those that are neighboring catchments.

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00:19:56.610 --> 00:20:12.299
Tamara Harms: We considered that there might be strongly a shared variance in temporal patterns between catchments that are monitored at the same site. So all of the headwater catchments at the Hubbard Brook site might share common patterns, for example.

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00:20:12.910 --> 00:20:33.449
Tamara Harms: we considered shared variance in at the Eco region level. So the different shades of green shown on this map that share a regional climate and vegetation patterns, or these processes might be responding all similarly to to changing climate and atmospheric deposition, in which case there'd just be a single

102
00:20:33.450 --> 00:20:54.520
Tamara Harms: pattern at the North American State. So these are represented, graphically from left to right, here, with on the left unique patterns for each had water catchment, and then moving over to

the single North American State. If all the temporal patterns and stream chemistry behaved similarly with some observation error thrown on there.

103
00:20:55.640 --> 00:21:19.509
Tamara Harms: And so we configured, configured these models with a a different state processes to reflect these spatial scales, and we found that the data overwhelmingly supported separate processes by catchment. So this is bad news for monitoring, because it needs means we need to monitor a lot of of catchments. If we really wanna unders use these data to understand how

104
00:21:19.680 --> 00:21:40.410
Tamara Harms: ecosystems respond to disturbance. There were the data supported unique temporal patterns among all of the headwater catchments even among adjacent catchments. And so this suggests that although these catchments are are experiencing similar long-term patterns in climate and in reduction, in atmospheric deposition.

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00:21:40.480 --> 00:22:10.039
Tamara Harms: There are local attributes of catchments that filter those effects and and change the ultimate output of of solutes from the catchment. So this is an example of a cross scale interaction. There is a regional pattern or a continental pattern in atmospheric deposition and climate, but local scale processes are filtering the effects of that those larger scale processes to generate the local scale pattern.

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00:22:10.930 --> 00:22:40.680
Tamara Harms: Okay, just to show you what some of those trends look like, we would expect declining calcium, ammonium, nitrate, and sulphate concentrations and streams. As a result of declining atmospheric deposition. These are the figure here shows those long term trends in terms of percent change per year on the y-axis, and then the different solutes on the X axis and the colors represent the different catchments. So at each observatory, which are the different color colors, multiple headwater catchments were monitored.

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00:22:40.820 --> 00:22:50.919
Tamara Harms: And the important thing to notice here is that not even all of the catchments at a single site showed the same, or even the presence of significant long-term trends.

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00:22:51.240 --> 00:23:14.910

Tamara Harms: So even though atmospheric deposition is declining, and and some of these trends are consistent with that declining calcium declining, nitrate and sulfate concentrations. Only some of the catchments showed those trends. There's heterogeneity among catchments, even at the same monitoring site. So, for example, Hubbard Brook is shown in the Lime Green. Here there were

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00:23:14.940 --> 00:23:21.449
Tamara Harms: 4 or 5 catchments, monitor to Hover Brook, and only 2 of them showed declining trends in calcium. For example.

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00:23:22.540 --> 00:23:40.639
Tamara Harms: likewise we expect increasing doc concentration over time to result from declining atmospheric deposition or from increasing precipitation, and we see that that positive effect on Doc in several catchments, but not all of them, and not even all of them at a given observatory site.

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00:23:41.830 --> 00:24:06.390
Tamara Harms: There were, however, shared trends in seasonality, so seasonality was approximately coherent within monitoring sites and across the the North American extent of these data. In the north temperate zone as well. So this is just showing you how seasonal each of these solutes were. So I'll just use nitrous as an example, because the seasonality is so strong.

112
00:24:06.390 --> 00:24:17.259
Tamara Harms: So we've got higher. Nitrate concentrations tend to happen in the winter and dip in the summer, when when productivity is is greatest and that pattern was shared across most of the catch.

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00:24:17.260 --> 00:24:21.070
Tamara Harms: It's in our data set as we're

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00:24:21.070 --> 00:24:33.720
Tamara Harms: trends and seasonality for many of the other solutes. So seasonal scale patterns tended to be coherent across the entire North American study region.

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00:24:34.430 --> 00:24:58.859
Tamara Harms: There are contrast in the amplitude among solutes that can help us understand. The relative supply of these solutes there's there are differences among sites and the timing of the peaks and

troughs which can help us build hypotheses about the processes leading to these patterns? But on the whole, seasonality was conserved across the the continental extent.

116
00:24:59.230 --> 00:25:04.409
Tamara Harms: Okay, so what are the implications of of these cross-scale interactions for monitoring programs?

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00:25:04.410 --> 00:25:29.390
Tamara Harms: Well, it means that post disturbance trajectories vary even among adjacent catchments. So if we really wanna get a sense of the regional ecosystem response to disturbance or recovery from disturbance, we need to monitor multiple catchments within that region that have attributes that are representative of the spatial heterogeneity present in the region. And it's things like aspect and slope and number and position of wetlands and

118
00:25:29.390 --> 00:25:37.270
Tamara Harms: altitude that are influencing differences among the differences in long-term trends among adjacent catchments.

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00:25:37.640 --> 00:25:44.000
Tamara Harms: If we want to capture seasonal dynamics, then we maybe just need a single representative catchment in each region.

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00:25:44.250 --> 00:25:52.620
Tamara Harms: Ii don't want to leave this on a on a dismal note suggesting that that I think we got to put a sensor in every stream. But

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00:25:52.910 --> 00:26:19.500
Tamara Harms: what? What this analysis really underscores is that recovery from disturbance takes multiple decades, and there are lots of surprises and perturbations within those long-term trajectories. And so really, the absolute, most important takeaway from this is that we just have to keep monitoring where we can. Introducing gaps and data. In time series is really the death knell for being able to do these kinds of analyses.

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00:26:20.730 --> 00:26:31.480
Tamara Harms: Okay. So a second example of cross scale interactions, comes from some ongoing work that I've been leading on fire and Airedland catchments.

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00:26:31.650 --> 00:26:50.429
Tamara Harms: So we know from a variety of analyses and and and looking at the fire data that fire in the aridland West is increasing in frequency, intensity, and the size of fires. So the map here shows Ecoregions in the Western Us.

124
00:26:51.220 --> 00:27:08.319
Tamara Harms: Here's a plot of all the fires on the Us. Part of that region. beginning in the eighties when the when the compiled National monitoring data set begins, showing that the number of fires per year.

125
00:27:08.320 --> 00:27:21.250
Tamara Harms: there appears to be increasing. Here's data showing the size of fires which also appear to be increasing and and actual statistical analyses that others have done bear this out.

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00:27:21.660 --> 00:27:49.210
Tamara Harms: So we're interested in how fire influences aquatic ecosystems in airlines, especially in the this context of increasing fire activity. So we built a conceptual model to try to to try to compile our hypotheses about about Hy, how fire could influence aquatic ecosystems. And then we're using data synthesis to test that conceptual model.

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00:27:50.030 --> 00:28:01.020
Tamara Harms: the conceptual model I'm going to show in 2 pieces. The first is that we recognize that these processes will vary across regional scale gradients in aridity. So this figure

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00:28:01.130 --> 00:28:14.270
Tamara Harms: shows aridity of a site. Along the X-axis here. So wetter sites on the blue end here and drier sites on on the site with this red line

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00:28:14.490 --> 00:28:34.980
Tamara Harms: and increasing aridity increases flammability. So that's what this blue to red line is showing as we go from coniferous semi arid forest to the Snoran desert, for example, the flammability of material in the Snoran desert is much greater because the moisture content is is so much lower.

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00:28:35.010 --> 00:28:58.380
Tamara Harms: But at the same time the fuel load also decreases along that gradient. So the these green lines show the fuel load. So moving from wetter regions to dry. So drier regions we get a decrease fuel load. There's just not much productivity in the desert. So there's the fire. Hazard is maximized at some point

131
00:28:58.450 --> 00:28:59.610
Tamara Harms: of

132
00:28:59.890 --> 00:29:03.050
Tamara Harms: in the in the middle here.

133
00:29:03.280 --> 00:29:24.060
Tamara Harms: but we can. We could observe shifts for a particular ecosystem depending on drought conditions. So a a typically water forest could increase in its flammable flammability. Following a drought, for example. And then the shift between these 2 green lines is depicting

134
00:29:24.060 --> 00:29:34.640
Tamara Harms: shifts between a wet and a dry year where a wetter year could produce huge production of annual grasses, for example that become fuel.

135
00:29:34.950 --> 00:29:57.589
Tamara Harms: Okay? And then we we put together these ideas about fuel accumulation and and flammability to think about how materials are moved from catchments to streams. And we conceptualize 4 processes here, first, accumulation of materials. So this is atmospheric deposition. Primary production, nitrogen fixation that allow materials to accumulate in between intervals of fire.

136
00:29:57.720 --> 00:30:04.090
Tamara Harms: We then have combustion processes that remove some of that material, transform some of that material to different forms.

137
00:30:04.240 --> 00:30:28.150
Tamara Harms: Those combustion products can then be transported to streams via hydrologic flow paths, and once they reach streams, those material inputs can then result in a propagation or a change in the accumulation and transport processes occurring within a stream. So an example of propagation is that following fires in catchments in New

Mexico.

138
00:30:28.270 --> 00:30:40.779
Tamara Harms: delivery of nutrients with ash caused increase in the production of macrophytes in streams. So change in the accumulation of organic matter in streams.

139
00:30:41.970 --> 00:31:01.990
Tamara Harms: Okay? So we are interested in testing these ideas across regional gradients and aridity. And we're currently compiling all of the data on stream chemistry we can get for the Western Us. I'm just gonna show you a a small example contrasting 2 ends of a hydrologic gradient in the West.

140
00:31:02.250 --> 00:31:14.370
Tamara Harms: And an important aspect of errand catchments is that the effects of fire might not appear immediately after the fire occurs, because we have to get precipitation

141
00:31:14.370 --> 00:31:32.830
Tamara Harms: to generate hydrologic connectivity, to move materials to streams. And so, because of episodic precipitation, we might observe, we might expect there to be lags between when fire occurs, and when we see those effects in streams. And again, we're trying to evaluate these processes across gradients in precipitation, timing and amount.

142
00:31:33.100 --> 00:31:39.789
Tamara Harms: Again, we're using Mars models here with effects of precipitation. The area burned

143
00:31:39.830 --> 00:32:06.270
Tamara Harms: and their interaction. And we're we're incorporating lagged effects. So we're we're asking about the effect of fire immediately after fire. A year, 2 years, 3 years, 4 years and 5 years after fire, and we're including an interaction effect of precipitation and fire. To account for that if we don't have precipitation, and there's no connectivity between the catchment and the stream. We wouldn't expect to see a change in stream chemistry.

144
00:32:06.390 --> 00:32:20.360
Tamara Harms: So the the the sites in this example. Data analysis are from the Santa Barbara coastal, long term, ecological research

program, and that is in a Mediterranean precipitation regime dominated by winter rains and summer drought.

145
00:32:20.380 --> 00:32:24.209
Tamara Harms: and a set of catchments in the bias. Caldera, New Mexico.

146
00:32:24.290 --> 00:32:31.149
Tamara Harms: which was monitored as part of a critical zone observatory that has both winter rain and monsoonal precipitation.

147
00:32:33.400 --> 00:32:50.750
Tamara Harms: Okay, so I'm gonna I'm gonna show you what these effects look like. On a figure here just in that immediately following fire 6 months window. So we're looking at the standardized effects as a precipitation here on specific connectivity. So saltiness of the stream.

148
00:32:50.790 --> 00:33:10.880
Tamara Harms: The effects of the size of the fire in the watershed and the middle set of effects here and then their interaction at the bottom. Each of these different symbols is a different catchment at that site, and the colors just in indicate whether the effects were significant. The the black being we're highly confident that this is a significant effect.

149
00:33:10.880 --> 00:33:32.079
Tamara Harms: So in this example, from the catchments at bias Caldera, New Mexico, the the strongest effects most consistent across watersheds were the positive, interactive, effective precipitation and fire which reflects that that lag in fire response, we need precipitation to generate hydrologic connectivity.

150
00:33:32.280 --> 00:33:57.259
Tamara Harms: Okay? So here's all the results for the New Mexico site. Again, we're just increasing the time since fire that we're looking for a fire effect. Notice that there's no significant effect of precipitation on specific connectivity in these streams at all, which is a little odd for desert catchments. But the geology here is very porous, so most of the hydrologic flux is actually vertical, and it takes a lot of intense precipitation

151
00:33:57.260 --> 00:34:12.270

Tamara Harms: to generate actual hydrologic connectivity between catchments and streams. And we are seeing a a strong and consistent interactive effect this week between precipitation and fire.

152
00:34:12.270 --> 00:34:19.779
Tamara Harms: So the fire effect is observed in the stream. When we have enough precipitation to connect the catchments to the stream.

153
00:34:20.239 --> 00:34:25.550
Tamara Harms: Now, we're gonna contrast that with the Mediterranean precipitation regime.

154
00:34:25.800 --> 00:34:40.040
Tamara Harms: And and we see quite different patterns here. So there's a very strong, consistent dilution effect of precipitation in these catchments. These behave more like a standard airedlin catchment.

155
00:34:40.060 --> 00:35:06.269
Tamara Harms: we've got groundwater contributing to base flow. But then, when we have storms that storm water dilutes the connectivity in the streams, there's very limited evidence for fire effects, or for interaction with precipitation, because this dilution effect is precipitation is just so strong and interestingly, the fire effects turn up in

156
00:35:06.320 --> 00:35:20.580
Tamara Harms: a longer duration after fire, which is also maybe counter intuitive because typically catchments recover over time from fire. But this region experienced a drought during this time.

157
00:35:20.670 --> 00:35:34.879
Tamara Harms: and so it's likely that that drought prevented a observation of fire effects in the early years following fire, and it wasn't until hydrologic connectivity was re-established. Following the drought that we actually see fire effects.

158
00:35:35.780 --> 00:35:49.510
Tamara Harms: Okay? So again, I interpret this as a cross scale interaction where macro scale processes, patterns occurring at at regional scales and hydro climate and fire regime.

159
00:35:49.930 --> 00:36:00.600

Tamara Harms: are interacting with local scale catchment attributes to influence stream chemistry. So rather than there being a single effect of a fire across these aridland

160
00:36:00.600 --> 00:36:23.020
Tamara Harms: ecosystems. The local catchment attributes their geology. For example, how water is routed is influencing the ultimate response to those macro scale processes of of hydro climate and fire regime. So the drought, and timing of precipitation, matter and local catchment attributes ultimately influence their response to regional scale gradients.

161
00:36:24.040 --> 00:36:41.389
Tamara Harms: Okay, last example, this is an example of a a potential cross scale feedback. We're gonna look at continental scale patterns and stream metabolism. This, these data were collected under a project funded by the microsystems biology program at Nsf.

162
00:36:41.600 --> 00:36:43.730
Tamara Harms: so

163
00:36:43.770 --> 00:37:04.050
Tamara Harms: one of the goals of of ecosystem ecology, currently of many ecosystem ecologists is to project project carbon emissions in a warmer future. We know that potential feedbacks between ecosystems and climate. Could could accelerate climate warming, and until the last, maybe decade and really

164
00:37:04.050 --> 00:37:14.620
Tamara Harms: 5 years or so, aquatic ecosystems were often excluded from these efforts. We we've learned a lot in the intervening years. But our project was

165
00:37:14.620 --> 00:37:21.429
Tamara Harms: W was intended to contribute there to to understand the role of aquatic ecosystems and interactions with climate.

166
00:37:21.670 --> 00:37:31.419
Tamara Harms: So we model the temperature sensitivity of metabolic balance in inland waters, particularly in in small streams.

167
00:37:31.600 --> 00:37:44.209

Tamara Harms: We. We modeled gross primary production and ecosystem respiration from dissolved oxygen budgets in these streams that were rate across 6 biomes from the Arctic to the tropics are are really subtropics.

168
00:37:44.930 --> 00:37:50.749
Tamara Harms: There they span a huge latitudinal gradient. And there's variation in local climate.

169
00:37:51.190 --> 00:38:20.009
Tamara Harms: So we're gonna use the temperature sensitivity of photosynthesis and respiration derived from this relationship between gpp gross primary production and er which are driven by dynamics of light, influencing gross primary production and temperature, influencing respiration. And then these processes are differentially sensitive to a temperature that these are their activation energies.

170
00:38:20.010 --> 00:38:29.670
Tamara Harms: So we're gonna focus on the difference in in those energetic requirements of gross primary production and temperature.

171
00:38:30.370 --> 00:38:54.239
Tamara Harms: And so looking at all of the data together across those 6 biomes. This is a sort of complicated plot, but it shows the ratio of gross primary production to ecosystem respiration, and each of the streams observed so productivity is increasing as we go to the right here, and then the Y-axis is the difference in the activation energies of photosynthesis and respiration. So above the 0 line. Gpp is more

172
00:38:54.240 --> 00:39:19.040
Tamara Harms: temperature sensitive below the line er is more temperature sensitive. And we notice that there's a relationship between the productivity of the stream currently and the temperature sensitivity of these processes, where more productive streams, ecosystem respiration is likely to ramp up more strongly in response to an increase in temperature, whereas in the less productive streams, gross primary production is likely to ramp up more

173
00:39:19.040 --> 00:39:21.659
strongly in response to increasing temperature.

174
00:39:22.480 --> 00:39:41.270
Tamara Harms: We also see a relationship between the current, daily,

mean temperature of each of these sites and the difference in these activation energy, so warmer sites. Again, respiration, more temperature, sensitive, colder sites, production, more temperature sensitive. And if we apply these results.

175
00:39:41.630 --> 00:40:00.060
Tamara Harms: to project changes in carbon balance, so net ecosystem production here the difference between GP and er, and we project. This is with a one degree, Celsius warming. We project that those warmer sites are likely to become even more heterotrophic.

176
00:40:00.240 --> 00:40:15.960
Tamara Harms: and their aquatic processes would then result in increased emission of carbon dioxide. So warmer streams, with greater Gpp become more strongly heterotrophic, become a stronger source of carbon to the atmosphere derived from in stream processes.

177
00:40:16.950 --> 00:40:41.620
Tamara Harms: So we don't document that this. In fact, we don't quantify the the effect of this potential increase in carbon dioxide release on climate warming. But I will pause it that that it would be a positive effect. So so that's why I call this a potential cross scale feedback. But so climate warming will result. In increased Co 2 emissions from warmer and more productive streams. Particularly at lower latitudes.

178
00:40:41.720 --> 00:40:51.509
Tamara Harms: and that increased. CO, 2, released from streams, then, would have a positive effect on climate warming. So a positive cross scale feedback.

179
00:40:53.440 --> 00:40:55.359
Tamara Harms: Okay? So

180
00:40:55.870 --> 00:41:20.250
Tamara Harms: I think II address Goal 3, that Lori laid out of the of the project which is to enable collaborative macro systems research. So I will just suggest that in my experience the value of these distributed sampling approaches toward macro systems, biology are that we can test drivers of regional to continental scale patterns.

181
00:41:20.660 --> 00:41:44.249
Tamara Harms: we can in particular test hypothesize cross scale

interactions and feedbacks. We need observations across of a similar nature and using similar protocols collected across regional and continental gradients to be able to test those interactions and feedbacks. But but placing our data collection in that context is really useful.

182
00:41:45.010 --> 00:42:00.629
Tamara Harms: and that we should consider connections both within and among ecosystems. So how might our sites be networked, or what are potential for exploring the role of connectivity within and among ecosystems.

183
00:42:02.160 --> 00:42:06.999
Tamara Harms: Okay, thank you so much. I'm gonna stop share so that I can see people.

184
00:42:10.800 --> 00:42:14.960
Laurie Anderson: Thank you very much. Tamara. That was a really fascinating talk.

185
00:42:15.080 --> 00:42:25.310
Laurie Anderson: I'd like to invite people for maybe 5 min or so to ask some questions in the chat, and

186
00:42:25.350 --> 00:42:28.430
Laurie Anderson: I'll read them out as they appear.

187
00:42:28.960 --> 00:42:35.279
Laurie Anderson: and we'll also have a chance to talk with Tamara in breakout rooms as well.

188
00:42:35.600 --> 00:42:39.480
Laurie Anderson: but maybe some Q. And a

189
00:42:42.090 --> 00:42:43.260
Laurie Anderson: anything

190
00:42:44.430 --> 00:42:46.459
Laurie Anderson: people would like to ask.

191

00:42:51.900 --> 00:42:54.590
Laurie Anderson: I actually have a question

192
00:42:55.050 --> 00:43:05.150
Laurie Anderson: while we're waiting for others to add to the chat. So the data sets that you're using in this or in other research that you haven't presented?

193
00:43:05.540 --> 00:43:20.739
Laurie Anderson: Are you mostly relying on like existing environmental data sets that are publicly available? Or are you leading a data collection effort that is specific to your

194
00:43:20.980 --> 00:43:22.310
Laurie Anderson: your research

195
00:43:23.330 --> 00:43:39.670
Tamara Harms: both. So the the North temperate stream example, those are data that are collected by others. There, there! Those are all technically publicly available. But there was some work to be done on those before we could use them.

196
00:43:39.970 --> 00:43:58.030
Tamara Harms: That involved lots of back and forth with the this data manager or data steward. At each of those sites. The airline firework is a mix of Usgs data, Ltr data. And we're hoping to roll in neon data,

197
00:43:58.090 --> 00:44:05.410
Tamara Harms: and anything we can pull out of the the Edi, the environmental data initiative catalog which encompasses most of the Ltr data

198
00:44:06.180 --> 00:44:18.620
Tamara Harms: most of us have worked on some of those catchments. So like, there's people from the Santa Barbara Ltr. Who actually collected those data. So it's a, it's a mix of of data that we've collected and

199
00:44:18.910 --> 00:44:32.150
Tamara Harms: but they weren't collected for this purpose. And then the stream metabolism, those data we we very arduously collected

ourselves with our own, including my own 2 hands and many, many graduate students who worked very hard

200
00:44:32.460 --> 00:44:34.310
Tamara Harms: and undergrads.

201
00:44:36.820 --> 00:44:45.640
Laurie Anderson: See, we have a question in the chat. From Claire lunch. What other additional data sets would be most valuable to you.

202
00:44:46.910 --> 00:44:58.090
Tamara Harms: I want continuous time series, Claire. I would like a sense like more sensors. I would like them to have been put into the streams 20 years ago. Thank you?

203
00:44:58.430 --> 00:45:12.210
Tamara Harms: yeah, I think I think for time series stuff just keeping up the time series is super super important and doing whatever we can do to avoid gaps, especially non-random gaps in the data.

204
00:45:12.290 --> 00:45:14.629
Tamara Harms: Other data sets. That would be

205
00:45:14.850 --> 00:45:17.599
Tamara Harms: useful.

206
00:45:28.590 --> 00:45:35.140
Tamara Harms: yeah, I think. Especially. Especially my work has taken a turn toward the Time series, just avoiding data gaps.

207
00:45:35.360 --> 00:45:49.070
Tamara Harms: Sure, we'd like more sites. But I take a long record from a single site over a bunch of spotty records at a bunch of sites. The the the issues for us are in putting the data together. And that takes a lot of time.

208
00:45:50.340 --> 00:45:51.090
Tamara Harms: Yeah.

209
00:45:53.360 --> 00:46:04.219

Laurie Anderson: we have another question. From Eric yi! I might have missed this, but how scalable is the temperature, sensitivity, calculations to smaller units.

210
00:46:04.340 --> 00:46:33.500
Tamara Harms: for example, is it applicable to something like petri dishes or small communities in a classroom or lab setting. Yeah, that that that relationship that we use is just a fundamental relationship. So I don't see why it wouldn't be appropriate to smaller scales. It's a it's a I realize when I was putting this together, that and I do teach undergrads as well. And so you know that that might be that might take a few class periods to explain and get them to a place of understanding what

211
00:46:33.600 --> 00:46:37.130
Tamara Harms: what that relationship is, and what it means, and how it was derived.

212
00:46:40.260 --> 00:46:45.630
Laurie Anderson: Actually, that that brings me to another question.

213
00:46:46.140 --> 00:46:55.519
Laurie Anderson: what? So if if you are teaching undergraduates as a macro systems ecologist.

214
00:46:55.970 --> 00:47:02.200
Laurie Anderson: What do you send of some of the fundamental ideas that you think are important to impart to them?

215
00:47:02.290 --> 00:47:09.040
Laurie Anderson: If you are imagining some of them going on to be contributors in this field. Somehow.

216
00:47:09.910 --> 00:47:18.270
Tamara Harms: II think thinking at macro skills is in some ways natural to them, and you know I'm not sure they they maybe don't.

217
00:47:18.330 --> 00:47:21.899
Tamara Harms: At least the students that I'm working with currently maybe, haven't.

218

00:47:22.430 --> 00:47:52.240
Tamara Harms: They haven't spent a lot of time outside. They haven't thought about dirt and streams, but they sort of have thought about the broader world cause they drive a long way to get to campuses there, like they're they're like unit of of scale that's relevant to them is maybe a little more aligned with macro scale thinking there. Many of them are interested in sustainability and there's lots of larger scale issues to do with sustainability. So I think they're motivated to understand it. So I would just teach the concepts that I that I laid out at the beginning of the talk.

219
00:47:52.240 --> 00:47:58.510
Tamara Harms: Those connectivity and teleconnections.

220
00:47:59.600 --> 00:48:14.630
Tamara Harms: teaching them what a feedback is, and then incorporating scale. the the ways that I've addressed these questions using statistical models in time series that that's probably outside of the scope of most undergrad

221
00:48:14.910 --> 00:48:30.370
Tamara Harms: courses. But understanding how we collect the data and how they can be used and how they can be used for different purposes. Lots of these data that we're using were collected to understand something about a particular place. But we're putting them together to understand larger scale phenomena. And so I think.

222
00:48:30.690 --> 00:48:38.490
Tamara Harms: understanding that they could contribute to that, or even studying a single location, could ultimately contribute, I think, is important to communicate

223
00:48:39.970 --> 00:48:40.860
Laurie Anderson: cool.

224
00:48:41.060 --> 00:48:51.580
Laurie Anderson: There's a question from Matt alo lemmons. I would be interested to hear a bit more about how you are interpreting the seemingly counter intuitive results

225
00:48:51.590 --> 00:48:58.179
Laurie Anderson: found in the fire example. And we'll we'll make this our last question before we move to breakout rooms

226
00:48:58.960 --> 00:49:19.779
Tamara Harms: the counterintuitive results. Well, we know something about the hydrology of these sites. So I'm not just speculating about the role of whether flow pads are primarily vertical in the New Mexico catchments and horizontal in the Santa Barbara catchments. I'm not sure which. Which counterintuitive

227
00:49:20.150 --> 00:49:46.319
Tamara Harms: result you're referring to specifically in in the in those particular cases we chose to work with catchments where the members of the group had lots of expertise with the particular catchments that becomes harder when we're just scraping data from Usgs. And we don't have necessarily particular experience with a site, although with enough people on the team, you have a sense of what's going on in that neck of the woods.

228
00:49:53.780 --> 00:49:55.410
Laurie Anderson: Alright.

229
00:49:55.690 --> 00:50:08.109
Laurie Anderson: So we're going to have you move into some breakout rooms for a few minutes just to talk over what you learned from the from the presentation. And,

230
00:50:08.690 --> 00:50:16.509
Laurie Anderson: we're going to put some prompts into the chat, and we'll also send them as a message to the breakout rooms.

231
00:50:16.790 --> 00:50:18.190
Laurie Anderson: And

232
00:50:19.330 --> 00:50:23.920
you don't have to. You're not obligated to discuss them all, obviously. But

233
00:50:23.940 --> 00:50:27.139
Laurie Anderson: these are just things to, you know. Kind of

234
00:50:27.810 --> 00:50:31.950
Laurie Anderson: get us, you know, get people thinking about

235
00:50:32.730 --> 00:50:44.109
Laurie Anderson: about macro systems, ecology, and how to apply what we've learned. So go ahead into the breakout rooms and we'll send you some prompts.

236
00:50:44.400 --> 00:50:45.889
Laurie Anderson: and that would be great.

237
00:51:04.360 --> 00:51:06.480
Tamara Harms: I don't see a breakout room.

238
00:51:06.590 --> 00:51:18.159
Jose-Luis Machado: not for you. I think we we do. Wanna go to one. Okay, okay, yeah. We wasn't quite sure. So we'll send you to room. Okay. Sorry.

239
00:51:19.260 --> 00:51:21.170
Jose-Luis Machado: Yes. So there you go.

240
00:51:21.640 --> 00:51:23.210
Tamara Harms: Thank you.

241
00:51:33.460 --> 00:51:37.340
Laurie Anderson: This is what I send them.

242
00:51:38.190 --> 00:51:40.870
Jose-Luis Machado: Oh, sorry. This is what I, yeah, yeah.

243
00:51:41.540 --> 00:51:50.730
Jose-Luis Machado: you're able to send it to all the rooms as a message. I think there's a broadcast.

244
00:51:50.950 --> 00:52:08.169
Laurie Anderson: We have another virtual event that is coming up on February 20 seventh. And this is a really interesting approach to community engaged research thinking about scientific storytelling.

245
00:52:08.560 --> 00:52:10.040

And

246
00:52:10.640 --> 00:52:24.109
Laurie Anderson: we've got the date and time there. February 20, seventh, 1130 to one Eastern time. You can go to our website and register for the event. It's a free event, just like this one was.

247
00:52:24.280 --> 00:52:31.190
Laurie Anderson: we are also going to be having an annual, A sec. Our second annual meeting

248
00:52:31.270 --> 00:52:52.009
Laurie Anderson: and we're going to be bringing existing project groups, working groups to that meeting for them to continue their work on developing projects. But we're also inviting some new participants to join us to develop macro systems projects. So if you're interested in that, and would like to apply to attend.

249
00:52:52.100 --> 00:52:54.909
Laurie Anderson: we have a link there to the

250
00:52:54.920 --> 00:53:02.630
Laurie Anderson: application. We'd also like to invite you to take our post meeting survey, which you can find a link in the chat.

251
00:53:02.790 --> 00:53:08.040
Laurie Anderson: and it's just a very short question about your impressions of the event.

252
00:53:08.550 --> 00:53:25.129
Laurie Anderson: And also, if you'd like to join Mifa as a participant we we welcome people who are active. We welcome lurkers in in the network who are just kind of interested in eventually getting involved.

253
00:53:25.300 --> 00:53:40.680
Laurie Anderson: So feel free to join Mifa and thank you again to Tamara Harms. What a really interesting talk! Wide, ranging across a huge scope of ecosystems, much appreciated. Thank you for your time.

254
00:53:41.010 --> 00:53:52.120

Laurie Anderson: And yeah. Much appreciated to all of you for spending
spending some time with us. I know there are many zoom opportunities
out there. So

255
00:53:52.450 --> 00:53:54.320
Laurie Anderson: so thanks for joining us.

256
00:53:55.500 --> 00:53:56.850
Laurie Anderson: and we're all set.

257
00:53:58.710 --> 00:54:01.169
Tamara Harms: Thanks, Laurie. Thanks everyone.

258
00:54:01.240 --> 00:54:02.450
Laurie Anderson: Thank you.

259
00:54:22.680 --> 00:54:35.870
Jose-Luis Machado: Nice to see Kathy there. Yes. So my question now
was to what's again was. I saw that? I saw that the

260
00:54:35.930 --> 00:54:39.760
Jose-Luis Machado: yeah, that did.