Mark Hall:

Several years ago, we needed to be able to test instrumentation at really cold temperatures. We designed and had installed, we call it a cold test chamber. It's basically a big walk-in freezer, but most freezers go down to about zero degrees Fahrenheit. Well, this one will go down to below minus 40. We can hold that temperature for long periods of time, so we can put equipment in there and test to the cold temperatures and look for issues that we're going to run into in Alaska.

Speaker 2:

You're listening to Further Together, the ORAU podcast. Join Michael Holtz and his guests for conversations about all things ORAU. They'll talk about ORAU storied history, our impact on an ever-changing world, our innovative, scientific, and technical solutions for our customers, and our commitment to the communities where we do business. Welcome to Further Together, the ORAU podcast.

Michael Holtz:

Happy Wednesday, and welcome to Further Together, the ORAU podcast. I am your host, Michael Holtz, and I am really excited to talk about one of the hidden gems of ORAU. It's work we've been doing for a while, but we don't always talk about it out loud at ORAU. So this is an opportunity to do that. We're going to talk about some of our atmospheric sciences work with NOAA and the ATDD program. And to talk about that, I have Kathy Rollow and Mark Hall joining me, and I'm really excited to talk to both of them. I'm going to let them introduce themselves. So Kathy, let me turn it over to you and have you introduce yourself, please.

Kathy Rollow:

I'm Kathy Rollow and I am the ORAU program manager over ATDD and then also, I support the IEV program on the ARRA side, independent verification, but I spend the majority of my time supporting the atmospheric research mission.

Michael Holtz:

Excellent. And Mark Hall, tell us who you are, please.

Mark Hall:

All right. I am the lead engineer for the ORAU team at ATDD for the Climate Reference Network program. I've actually worked here for 36 years, but about the last 21 or 22 years, I've been working on the CRN program.

Michael Holtz:

Gotcha. And for the folks who don't know the NOAA, National Oceanic and Atmospheric Administration, Atmospheric Turbulence and Diffusion Division, talk about what the NOAA ATDD is all about. What do we do? Why is it important?

Kathy Rollow:

I guess I could kind of start. I don't have the area expertise that Mark has, but we have several staff in Oak Ridge and in Idaho Falls that support NOAA ATDD, which is part of the Air Resources Laboratory. And our primary mission in Oak Ridge that we're supporting NOAA with is climate research, boundary layer characterization, and atmospheric chemistry and dispersion. Those are the areas of research that they do. Now mark manages that Climate Reference Network, which I'll let him speak to. So that's what's gathering the data that feeds the researchers so that they can do. Now they're reporting what's happened. And Mark can correct me if I'm wrong, I don't think we do a lot of modeling, like forecasting. We have some towers that feed, what people normally think of as NOAA work, is the National Weather Service. So we had some towers that the National Weather Service that Mark and the group maintain that the National Weather Service gathers data from, but they're not doing weather research or predictive modeling. Is that correct?

Mark Hall:

Yeah, that's pretty correct. Yeah.

Kathy Rollow:

So I was just going to say, there's some other interesting things like that on the other side of the research side that they do. We have some people, ORAU employees who maintain, I think it's called Urban Net, if that's the appropriate way to say it. It's like urban towers that are inside Washington, D.C., so they can use those to forecast hazardous material dispersion, and also to predict whether that what can happen during a climate in urban areas, because it's in unique atmosphere.

Michael Holtz:

And in urban areas, you have a lot of concrete and stone and very reflective, hot materials, which I know in a city like Washington, D.C. this time of year is very, very steamy. And not a lot of green space, at least in the city proper itself. So Mark, you mentioned the Climate Reference Network and talk about some of the work we do with that. Just for folks who are listening, we've done some drones up in hurricanes and there are Climate Reference Network spots, towers kind of all over the place that we're sort of monitoring and keeping abreast of. And so talk a little bit about some of those projects.

Mark Hall:

So I'll give you just a little brief history of why the Climate Reference Network came to be. When climate became a real big topic, the climatologists started looking back at the data they had and, historically, the climate data for the United States came from a network called the co-op network. And the Weather Service oversaw that, and it was basically a network of volunteers in the Weather Service supplied the equipment. And when they started looking at that data, there was a lot of issues with the data.

 For example, some of the sites started out, they were in the country, but then as the area developed, it became a suburban and then urban areas. There was a question about what actually was real climate change and how much was just change in the local environment for the stations. That's just one example. The head climatologist, there's a data center over in Asheville, North Carolina, where all the climate data for the country is stored. And at that time, the director there, his name was Tom Karl.

 And he came up with the idea to design a network that is just designed for climate monitoring and it addresses all the issues that we have with climate data. That became the Climate Reference Network. It's not in the National Weather Service, and there are some reasons for that. I won't get into that, but the Climate Reference Network, our stations are fairly distributed across the United States. We have 114 stations in the Continental U.S. There's right now 23 stations in Alaska. And we plan to install another six or so stations in the next three or four years to bring that up to 29 to 30 stations. And then there's two in Hawaii. Those stations are the primary measurements there are temperature and precipitation, and now some soil measurements that we make.

 And the locations were picked, so that they're in areas that aren't going to be developed. Most of those are in national parks, wildlife refuges, other federal lands, nature conservancy lands, university properties, things like that, where there should not be influenced by human development. And then there's a lot of redundancy in our measurements, for example, the temperature measurements. We have three sensors there. The ideas is, if those three sensors agree with each other, then you've got a lot of confidence in that data. If one of those sensors fails, it's obvious in the data and it can be flagged and taken out.

 And another thing we do is we visit these stations once a year. And during those visits, we do some calibrations. One of the things we do is, for example, is replace one of the three temperature sensors with a newly calibrated sensor. So all those sensors are re-calibrated on a three year rotation. The calibration record is kept and it is part of the record. Then we also do a photo documentation and some actual other documentation to verify that the site characteristics haven't changed. And if there's anything going on, it's obvious in the photos. And we document that and turn that in.

 So the data comes from our stations. It's transmitted by GOES satellite every hour. A lot of the data is taken every five minutes. We have five minute averages for temperature and precipitation, some other things. And that data lands over at the data center in Asheville, North Carolina, and it goes online and then they process it over there. There's some daily summaries, monthly summaries that are produced. And then the data also goes out to the Weather Service and they ingest that and use it in some of the forecasting and other things like that.

Michael Holtz:

Mark, what does the data from the Climate Reference Network, from a big picture perspective, what does it tell us about what's happening across the country?

Mark Hall:

The purpose of the network is to provide a set of data that we have a lot of confidence in. It's called a reference network in that other measurements or networks or stations can be referenced to this network to see if they agree with what's going on here. Or if those stations, if you're seeing some change there, that may be on a local basis. The climatologist used this to look at their climate models and then also to verify other data and to ingest it.

 One of the things about the climate, there's a lot of discussion about climate, but everybody would agree that you want good data. No matter where people are on the spectrum, they want good data, good quality data so that you can see what's actually happening over time. And like I said, this network was designed to handle a lot of the issues that you see in data from other places. Because of that, over time, it's like with the co-op network still exists. As time goes on, they'll be able to compare the record of the co-op network to what the Climate Reference Network has done and then see, okay, are there these issues that you would suspect might be there? How big of an influence are there? And then by that, they can actually go back in time hopefully and correct some data that exists before the network was here.

Michael Holtz:

Gotcha. That makes perfect sense. And I know, Kathy or Mark, we have researchers, I'm thinking of Dr. Krishnan, they're looking at, even some of the upper-air weather and how it's impacting, how fluxes in the atmosphere are impacting climates in places like the Arctic and other places like that. How does what happens at ATDD... I'm not sure what my question is. I guess, how does that work? How do we get that kind of data in addition to what we're doing with the Climate Reference Network?

Kathy Rollow:

I'd like to just point out, and I think that Mark kind of almost made this clear, our scientists and engineers are very conscientious not to be involved in the political side of what can be done.

Michael Holtz:

Absolutely.

Kathy Rollow:

That has nothing to do with our mission. And even when we have some research that's released and it gets used for whatever, if it becomes publicized, I think that they almost consider that kind of a failure. They just want to present the facts and let somebody else interpret it. So I guess that explains a lot about, I guess, his response. And I think you did a great job in your response, Mark.

 A little bit to answer about what you're talking about, and I should have mentioned this earlier, is our small unmanned aircraft systems. So that's a lot of what you're talking about. How do you get the gap of what you're going gather between what the satellite can pick up and the Earth's surface?

 And we support that mission a lot. We have engineers who are working on the sensors that are placed on it. We have pilots that are flying the crafts. And so there's a lot of support from ORAU that's there. And that's important because, and not that we do this a tremendous amount, but it does allow you to gather data in atmosphere that man can't be in, in dangerous or remote areas. Obviously in the past, not recently, we've had some data where they tried to flew into extreme weather conditions.

 And obviously we're going to soon start gathering some data. We've got some new work that NOAA passed us down through the new infrastructure funding that's coming down. We're going to have disaster supplement and wildfire funding that's coming for us to gather some information to better predict the impact of wildfires. And also so that NOAA and the National Center for Atmospheric Research can find ways to better share data across the two groups. So I hope that answers your question. That's a little bit about another way that we're collecting data at a different, I guess, elevation,

Michael Holtz:

Right. The whole process is data collection. We've got the Climate Reference Network. We've got satellite data. We've got drones that we send, I know in the relatively recent past, up into hurricanes we've sent or dropped rounds from airplanes to collect data. And really and truly, Mark, as you said before, our purpose in all of this is to collect and present, this is the data we have. This is what's happening at these locations across the country, around the world, depending on the data we're looking at.

 And we've got the Climate Reference Network, and Mark, as you said, the co-op information and is it all jiving? Basically. We are sort of proving or disproving, as the case may be, the data is the data and that it makes sense. And that the co-op data eventually lines up with the climate reference data. And as you said, it's not for political purposes, it's for the presentation of data to say, here's where we are. This is what's going to be.

Mark Hall:

One thing I'll say too, is we do, at times, there's a lot of satellite data that gets taken. They do ground surface temperature data and they've started doing soil moisture data. Our stations at sometimes are used as a ground truth or a check on satellite data. They look at their stations to see as the satellite scans over that area. How well does that agree with the satellite readings? Anyway, that's used in that way also.

Michael Holtz:

Awesome. From just a career perspective, as someone who might be interested as a prospective NOAA ATDD worker, what kinds of work? And Mark, I think you're an engineer? There are meteorologists, I know. What kinds of people do this kind of work?

Mark Hall:

So for my group, we have several engineers and then engineering techs. We have quite a few people that travel on the road. I think right now we have two people that are traveling to Colorado and Wyoming. Each of our stations, we visit once a year. The people that work for me have technical skills, but they also get to travel quite a bit. That's a plus and a minus. I think there's quite a few of us that have been to all 50 states. I've been to all 50 states multiple times. Some of the places we go are pretty nice. We've got sites in a lot of national parks. We got Yosemite.

Michael Holtz:

Glacier.

Mark Hall:

Glacier National Park.

Kathy Rollow:

Hawaii.

Michael Holtz:

Hawaii.

Mark Hall:

So it's quite a bit of travel.

Michael Holtz:

I volunteer as tribute. I'll just put that out there.

Mark Hall:

We get that all the time.

Michael Holtz:

I bet.

Mark Hall:

It's funny. Our techs, sometimes they laugh about that. They say, well, after a while, it just turns into work no matter where you are. There's some truth to that. We've got some pretty crazy travel stories in house, pretty entertaining. You get our guys together and they can tell a lot of the stories. We also have in the lab, we have people that are data people. One of the people, scientists, Tim Wilson is a soil scientist here at the lab. And he has been working with the CRM program quite a bit to help us figure out what sensors are the best. How do you interpret the data that we have in different soils? It's interesting in the soil community, there's a soil sensors out there, but a lot of those are in agricultural areas primarily. Our sites are in all types of environment. When you get these sensors in these different environments, exactly what does that data mean? And how do you interpret it? We've got the scientists here. There's also people that are data analysts and all. It is quite a range of skills that we see.

Michael Holtz:

Gotcha. The folks that are, you mentioned for the Climate Reference Network, calibrating the sensors and those sorts of things, is that what your folks are doing when they're on the road, is kind of checking the stations and making sure the calibrations are correct?

Mark Hall:

We do calibrations here in house. We've got a calibration bath for the temperature sensors. We've got a wind tunnel here we use for doing the wind sensor calibrations. We've got a relative humidity chamber that we can use. Then in the field we calibrate the precip gauges to make sure they're accurate once they're on site. We do a lot of calibrations. We got a lot of expertise on that. And then we also do some research too. We've got sites in Alaska that are exposed to some pretty severe environments. One of the things we did several years ago, we needed to be able to test instrumentation at really cold temperatures. So we designed and had installed, we call it a cold test chamber. It's basically a big walk in freezer, but most freezers go down to about zero degrees Fahrenheit. Well, this one will go down to below minus 40.

Michael Holtz:

Oh my.

Mark Hall:

And we can hold that temperature for long periods of time. So we can put equipment in there and test it at cold temperatures and look for issues that we're going run into in Alaska.

Michael Holtz:

Okay. So you would do that before you exposed it to the actual harsh temperatures in Alaska?

Kathy Rollow:

Michael, it's not just sensors, it's also the batteries. They've tried solar. They've tried wind. They're constantly trying to figure out a better way to maintain the systems to where they can take the harsh extreme environment and send the data back consistently.

Michael Holtz:

That's amazing. To me, that sounds like a lot of work in and of itself just to keep the network going, especially in those places like Alaska and the harsher northern climates, but even in places that are severe weather-prone, like the kind of hurricane and tornado belts, making sure the equipment can withstand some of that.

Kathy Rollow:

Fencing. Mark had worked with some other people and they came up with an inventive way to put fencing around. If you're going to get the accurate readings, you can't have it blown out or you have to be able to maintain the area to where it will take accurate collections. It's so complicated and they're so inventive and it's just a constant push to try to figure out a better way to do it. They do an amazing job.

Michael Holtz:

That's awesome. And to keep, how many stations, Mark, did you say, 130?

Mark Hall:

Yeah. Sometimes it's around 140 nationwide.

 And to what Kathy was talking about, we have a NOAA scientist, he participated in a World Meteorological Organization study a few years ago. There were several test sites around the world. We had one that was outside of Boulder, Colorado that we instrumented. Our team put quite a bit of instrumentation in there and worked some people over in car. His name is John Kochendorfer. John and I and another scientist at NOAA came up with a design for a wind fence. All our precip gauges have wind fences around it because, as Kathy was saying, the wind can dramatically affect the catch of snow and pluv gauges under report. That study was to look at that. And from that study, we came up with a new design that I think we're about ready to start implementing, installing those at our stations.

Michael Holtz:

That's amazing. I imagine you have to create these wind fences and whatever battery packs to not only withstand the weather, but also to not impact the data.

Mark Hall:

Yes.

Michael Holtz:

So that in and of itself has to be a tremendous challenge.

Mark Hall:

We have quite a few stations that run on AC power, but then we also have quite a few that are either solar-powered and then we also use some wind power. And then in some of the extreme places in Alaska, we use a methanol fuel cell.

Michael Holtz:

Okay.

Mark Hall:

That's one of the big reasons for this cold test chamber because the methanol fuel cell, it uses methanol as a fuel. It produces some heat, but you have to keep it up to a certain temperature for it to perform. One of the engineers here, Michael Black, he worked on the design to... We basically buy a big insulated container, put the fuel cell in that, put our batteries in it, put the methanol fuel in there. And then it regulates its internal temperature. And we've been fairly successful at getting those systems to run in Alaska where it gets down to minus 50 minus, it could be down by minus 60 degrees and that system runs all through the winter. That's a big accomplishment.

Michael Holtz:

That work alone truly fascinates me. And just how you keep all of those stations going and the various climates and the various needs of the area where those stations are located. It just blows my mind. And Kathy, as you said, how creative and inventive the team is in making all of that work.

Kathy Rollow:

The stories are endless. Believe me, it's amazing. They do an outstanding job.

Michael Holtz:

I love it. Is there anything I haven't asked you about that you want to make sure that we cover or that you want to say about the work or the team?

Kathy Rollow:

I think I would, if you don't mind some shameless plugs, just some things that we didn't quite mention that I think are just fascinating. I know we've done this work for over 40 years and I bet we're getting close to 50. We probably need to do some research, but we supported NOAA in Oak Ridge for so, so long and we have an outstanding relationship with the customer and it's just an amazing group. It really is. And not only in Oak Ridge.

 We also have people supporting under the Air Resources Laboratory in Idaho Falls and then something else that we also do that is in complement to the NOAA work, we also have a grant through the National Science Foundation where we're doing Arctic research. Some people that support NOAA are also supporting NSF directly. We're teamed with Harvard on that. They're looking at carbon emissions in the Arctic, trying to bridge the gap between local data and some large-scale data that's already out there. And they are actually traveling fairly soon. They're going to utilize the NOAA tower and then also do some flights to collect some data up there. We are growing so much in this area. It's slow growth, but we really, really are growing. We're probably going to be up at least a third on our revenue over the next two years. So it's coming along slowly but surely.

Michael Holtz:

It just seems like there's more and more data that needs to be captured so the need is there. And you have, as you both talked about, inventive brilliant team members that are doing some amazing work. I look forward to learning much more and I would love to come back and talk about the NSF Arctic air research once they have some more of that data in house. I know I've had the opportunity to talk to Dr. Krishnan a little bit about some of that work, but when they have more results after they've done some of the flights and that sort of thing, I would love to talk more about that.

 Well, Kathy Rollow and Mark Hall, thank you so much for joining me for this episode. It's absolutely fascinating. I want to hear the stories of the travels and the inventions for the Climate Reference Network stations that are being deployed. I know we've touched on some of them and I just think it's amazing that you can create systems to keep the stations operational and collect the data and not interfere with that data collection and everything. It amazes me, so personal hats off to the whole team from me, just for the opportunity to talk about it.

Kathy Rollow:

Thank you, Mike.

Michael Holtz:

Thank you both so much. Have a great rest of your day.

Speaker 2:

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