

## Climate Webinar Transcript – Mar 2014

Thank you all for standing by, and welcome to our March webinar entitled 'Adaptation and forest management in Great Lakes forests: custom-made, real-world Examples'. These webinars are an initiative of The Ohio State University Climate Change Outreach Team, a multi-departmental effort within the university led by Ohio Sea Grant, Office of Research, Ohio Supercomputer, OSU Extension, and eight other OSU departments, to help localize the climate change issue for Ohioans and Great Lakes residents. I am Jill Jentes-Banicki from Ohio Sea Grant and Stone Laboratory, and joining with me today is Stephen Handler. Stephen is a climate change specialist at the Northern Institute of Applied Climate Science within the USDA Forest Service where he oversees the Northwoods Climate Change Response Framework, a collaborative approach to encouraging climate-informed forest management. His primary efforts are climate change education and working with forest managers and landowners to incorporate adaptation ideas into their work. We are delighted to have Stephen here today to talk with us about this innovative program.

Before we get started, a few logistical issues. During our presentation all participants will be in a listen-only mode. Afterwards, I will conduct a question-and-answer session. If you would like to ask a question during the presentation, please feel free to use the 'chat' feature located on your right-hand side of your screen, and I will collect and pose your questions out to Stephen at the end of his presentation. We have over 150 participants so far on this webinar; a great diverse group representing governmental agencies, academia, and nonprofit groups from the Great Lakes and around the country. Please keep the questions coming throughout the presentation, and we should have a great Q&A session. As a reminder this webinar is being recorded and will be posted onto our website for later viewing. Also, we will post a webinar survey in our 'chat' feature towards the end of the hour. Please take a few minutes after the webinar to fill out that survey. It will help us continue to bring you better webinars. If you need an attendance certificate for professional development, please email us after the webinar.

Without any further delay, I'd like to introduce Stephen Handler who will present 'Adaptation and forest management in Great Lakes forests: custom-made, real-world examples'. Now Stephen, I'm going to put your presentation up. And you should have the ball; you should be all ready to go.

Okay, perfect. Can you hear me okay?

You sound great!

Thanks, Jill. And thanks to you all for listening and hopefully chiming in with your questions. I'm looking forward to the back and forth at the end of this, even though we'll be kind of working through the 'chat' screen. It's always a fun part of these webinars to see what sort of response we get. So like Jill mentioned I'm here to talk about climate change and adaptation in forests in the Great Lakes (GL) region. But before I dive in, first I should pause and acknowledge that I'm going to be sharing a lot of work and a lot of our thought process from NIACS, the Northern Institute of Applied Climate Science. So it's important to acknowledge that much of this has been contributed by my colleagues and teammates here at NIACS. I'm going to be steering some of you all to some of my teammates here who work in

particular regions of the US, so you may want to follow up with these people in the future with more detailed questions. I think some of my NIACS folks might even be on the webinar today, and I bet they didn't know I was going to put their picture up for everyone to see, so there you go guys.

So just briefly about us at NIACS. It's a mouthful, Northern Institute of Applied Climate Science. We are sort of a funny hybrid within the Forest Service and the federal government. We're a chartered group, and specifically we're designed to be a bridge, and a bridge that connects some of these more esoteric, academic fields of climate change, carbon science, bioenergy, and bridging those fields with the needs and interests of forest managers, folks who live and work and play in forests, and really the whole cross section of the forestry community. So it's a fun spot for us to be in; helping make sure that science and information is communicated effectively to managers and landowners, but then also going back the other way and making sure that researchers know what the needs and questions are coming from the management community. We're a chartered institute. The organizations you see here below all are folks that help shape us and kind of dictate where we work and how we work, so all three branches of the Forest Service are members of our charter, also the National Council for Air and Stream Improvement, Michigan Tech University, and the Trust for Public Land.

I'm going to be talking broadly about a big effort we have going on across the GL region and much of the eastern US called the 'Climate Change Response Framework', and what this is is basically a collaborative approach to encourage climate-informed forest management. And this work really started with a pilot in northern Wisconsin in around 2009, which quickly expanded to the whole Northwoods region across Minnesota, Wisconsin, and northern Michigan in 2010 and 2011. Branching out from there into Central Hardwoods region in Missouri, Illinois, Indiana. Also Central Appalachians project in Ohio, West Virginia, and Maryland. And then just in the past year we've launched three new climate change response framework projects. Two in the eastern US, Mid-Atlantic and New England states, and then a third one launched specifically looking at urban forests. This project is beginning with a pilot in Chicago, and major partners include Chicago Wilderness, Morton Arboretum, Chicago Botanic Garden, and the Field Museum in addition to the Forest Service. So each of these Climate Change Response Framework projects is kind of operating under a consistent banner with a consistent approach. I'm going to touch on some of that later. But for those of you who are interested in certain portions of this landscape in particular, you may want to reach out to us and find out specifically what sorts of resources are available for your area. Now some of you on this webinar may have also heard recently about the USDA's newly launched regional climate hubs. I don't have any slides or information about that today, but I will say that NIACS, our group, runs the sub-hub for forestry in particular. And these Climate Change Response Framework projects will be the primary delivery mechanism for information and resources to forest managers in the Midwest and eastern US.

So I heard a wise person once tell me that before you launch into a presentation, it's always important to motivate the talk and to answer that question that's on everyone's mind: so what? Why am I sitting here in front of my computer giving up my lunch hour on a bright and sunny winter day (at least it's still winter up here in Houghton). And basically I don't think I'll need to spend a whole lot of time on this, but it's important to get across that forests are obviously a central feature of our landscape in the GL. They sustain us in many ways, economically, ecologically, and culturally. And we're kind of blessed with

a huge diversity and range of forests in this region. Apologies to all of the Canadians on the call. I know that it's not just empty space up above Minnesota up there, but the maps I have today are mostly just looking at the United States, but you guys get the drift, I'm sure. So we have a great range of diversity of forest types in the GL. Forests are also the majority land cover in our region.

The climate has shaped these forests over centuries along with factors like soils, glacial events, natural disturbances, and human management decisions. And we also have a really interesting mix of ownerships. What sorts of organizations and entities own these forests across the eastern US and Canada is really different than a lot of parts of the country. Most of the forest land that you see here in the eastern US and within the GL region is privately owned. That's different about this region when you compare to say western states. Now there is a bunch of public land as well. National forests, state land, particularly in the Northwoods region (Minnesota, Wisconsin, Michigan). And so what that means is that we all have a stake in ensuring that our forests remain healthy over the coming decades. Either you own it directly, the landowner, or you own it as a citizen, and you have a stake in maintaining the health and vitality of these forests over the long-term.

Now with that huge mix of forest types and forest ownerships, we naturally have a huge diversity of ecosystem values and benefits that we derive from forests. And this is a good thing that we, whether we're getting access to recreation, wildlife habitat, timber products from our forests. We're relying on them for a huge diversity of things. And what comes with that is a lot of management complexity. Forestry is a complex field. I don't need to tell any of you this, if you are professionals from your day job. But it's a tricky thing, you can imagine, to juggle each of these interests and goals, to respond to unexpected events like pest outbreaks and blow downs, also planning for the long-term, and dealing with uncertainty. Forests you can think of as a crop, but it's a really extended crop, it's not like a corn field that you're managing on the yearly rotation. You're thinking about 50, 60, 70, 100, 120 years into the future, so you can imagine all the complexities that come with that.

And now why we're here talking today is that we have climate change as kind of an up and coming source of additional uncertainty, additional complexity. It's a new issue for many foresters and natural resource managers that we're beginning to grapple with.

So to step in and try to fill that need or help managers think about climate change and their work as forest managers and landowners, NIACS and several partners are working together across large landscapes to understand potential risks and opportunities associated with climate change. I mentioned that big kind of umbrella effort called the Climate Change Response Framework earlier. You see the url here at the bottom. I would encourage you all to go learn more about this project. We have more things going on than I'm going to be able to cover today. One of the things I want to talk about briefly here in the next ten minutes or so is one of the major investments in time and energy that we spend in each of these landscapes where this project is working. One of the first things we try to do is work with local partners to develop a vulnerability assessment; a picture of what's at risk, what's likely to change in forests in each of these places. Now we're currently preparing a series of five vulnerability assessments across the eastern US. I'll tell you very briefly about them and give you a very quick tour. You see the Central Hardwoods landscape down there in the bottom in yellow. The vulnerability assessment for

Central Hardwoods forests was recently published. I'll put up a url for that later. Central Appalachians region in blue has a vulnerability assessment coming later this year. You can contact us right now for a draft, if you're interested.

I'm going to zoom in very quickly to the Northwoods, Minnesota, Wisconsin, and Michigan again. Because of the abundance of support and willing partners we actually chopped up the Northwoods into a series of three assessments; you see those here in the landscape. Kind of a Northwoods West, Northwoods Central, and Northwoods East. And these are also scheduled to be published in the next couple of months. Michigan should actually be out any day now. I'm just waiting for the email from our publications group. Minnesota will follow later in the spring, and Wisconsin will be ideally this summer. Again you can contact us now for drafts. I actually put the url up at the bottom if you want to see drafts of these assessments that are suitable for sharing.

Very, very briefly, kind of a high level overview of what we're trying to accomplish with this vulnerability information. Like I said, we're helping forest managers and other landowners, natural resource professionals get a sense of what's at risk and what's likely to change in forests over the next century. A couple of key things. Number 1, these assessments all rely on a range of future climates rather than picking one future and telling managers 'this is what we expect, and you better prepare for this'. We work with a range of plausible futures to give managers a sense of their risk and opportunity across that full range. I'll mention that more in a minute. These assessments don't include projections of socioeconomic changes that may come over the next several decades. We don't include any projections of, you know, urban development or changes in agricultural policies, fire suppression policy, things like that, some of those larger decisions that will obviously affect the landscape. We kind of have to hold as status quo for a lot of these assessments, and in a way that makes sense because we're looking at what's the risk if everything were to remain the same. And then finally, these assessments are not about making recommendations or telling forest managers what they need to do in order to respond to this risk. Rather, it's kind of a soup to nuts presentation of here's our best available information, here's our best available science on what's likely to change. I'm going to give you guys a very brief tour of the kinds of information you'll find in these assessments. This is just to kind of whet your appetite, and show you what sorts of things we try to put together in this package ultimately to come up with information on climate change in forests.

Okay. So first, in addition to a bunch of local information about the context of forest ecosystems in each of these landscapes. How, you know, where forests exist, what kinds of forests exist, how are they managed, how are they owned in each of these landscapes. We provide a lot of information on what has already been observed with regards to climate change in each of these places over the last 100 years. You see here a quick example from that Northwoods Assessment of northern Wisconsin and the western UP (upper peninsula). We draw on information from the climate wizard to present observed trends in temperature and precipitation over the last 100 years, so you'll see a lot of information like this.

We also draw on other published research and literature for how the climate has changed. This is an example of a paper from Saunders et al. that looked specifically at intense rainfall events across the

Midwest region. So these figures show you specifically how has the frequency of rainstorms of three inches or greater changed across the whole state of Michigan and the whole state of Wisconsin over the last 50 or 60 years. This is a trend that is consistent across the upper Midwest. Along with research like this, we also pull in several case studies for ecological indicators of climate change, like bird migration data, lake ice duration, things like that. So you'll find those sorts of summaries in these vulnerability assessments as well.

Now when it comes to information on projected future climate, I mentioned that our position is to present a range of plausible future climates, and how we do that is basically we try to bracket the full range of uncertainty when it comes to what's a likely future climate going to be for a given area. And in order to do this we try account for the two major sources of uncertainty when it comes to climate change projections. The first source of uncertainty is just the different outputs you get depending on which general circulation model you choose to spin the climate forward into the future. I won't go into a lot of detail about this unless you guys have questions. But basically our approach here is to pick a, kind of a low sensitivity model or a model that doesn't give you a lot of change if you pump it full of greenhouse gases. So on the low side we have a model like PCM. And on the high end of that bracket we use a model that has high sensitivity to greenhouse gases. So if you put in the same amount of greenhouse gas and spin that model into the future, it projects a higher amount of change. That's a more sensitive model. Okay? So that's how we account for the first big uncertainty that I mentioned.

Now the second big uncertainty has to do with choices that we humans haven't made yet. Right, we don't know what our level of greenhouse gas emissions are going to be 40, 50, 80, 100 years into the future. It really depends on how some big choices play out across the globe. So in order to deal with that uncertainty we use different storylines of the future that have been developed by the IPCC. And these storylines basically give us a narrative of what we would expect for future greenhouse gas emissions. So again in order to do the bracket thing, we take a low emission scenario, basically this is the storyline that we convert pretty quickly to alternative sources of fuel. We get off coal, for example. And on the high end of that bracket we go with a storyline that is more like our status quo pathway for greenhouse gas emissions going forward into the future, so we continue to rely on fossil fuels. Okay, so that kind of sets up our low and high end of the bracket.

Now when we go forward what you'll see is in each of these assessments we provide a downscaled climate change projections using those two scenarios that I just spelled out for you guys. And we use a consistent dataset for all of the assessments that I mentioned earlier. Each place we're doing a vulnerability assessment we use those same low and high scenarios. And we present this kind of information at three different time periods over the 21<sup>st</sup> century, so there's kind of a near-term, a mid-century, and then a late-century set of information that you can rely on as a manager.

Okay. Another thing you'll find in these vulnerability assessments are results from forest impact models. So there's a couple of these. These assessments all rely on a coordinated series of ecosystem models to kind of inform how forests may change under climate change. This is just a quick example from Tree Atlas that shows what is the suitable likely to be for a given species at the end of the next century under those same two climate scenarios. Another example from a model called LANDIS, which is, it actually

runs dynamic simulations over time, so tree cohorts are born, they grow, they compete with other trees, they migrate, they reproduce and die, it's very dramatic stuff in this model. You can also introduce disturbances like wind, fire, and timber harvest, and outputs look like this. You get estimates of biomass for a given species across a landscape over time. You also get species distribution maps. You can look at where a given species is likely to live at the end of the century. In addition to model results, there's also a lot of other published literature and information on potential impacts to forests under climate change. In each of these assessments you will see a big literature review with summaries on topics like this, so if you're interested in what's our current state of understanding on some of these potential benefits or potential stressors, we do our best to summarize that up in a tidy fashion for you.

And then finally we don't just jump from information on models and literature to conclusions about what's at risk. Each assessment has relied on an expert panel process so a deliberate approach to incorporate information and input from local forest managers and researchers. Each of these expert panels had a mix of federal, state, tribal participants, conservation groups, academic institutions, and also a range of disciplines. So this was an opportunity for a big cross section of the forestry community to all come together, kick the tires, examine this climate information and research, ask a lot of questions, and then contribute their own knowledge and expertise. And so ultimately we drew conclusions about vulnerability for each kind of forest in each place, and then also our confidence in that vulnerability range. So you will see information like this in each of these assessments in addition to a lot of information about individual species that you come up with from the models. We also put together the whole story for you, so in each vulnerability assessment I'm showing an example here from the Central Appalachians, but basically you'll find a two page summary that kind of lays out the key factors that drive, or that drove the group's decision of risk for a particular forest type. Each assessment area had to use different categories of forest systems for each place because obviously of the diversity of forest types and also the different nomenclature used by partners in each place. So in the Central Appalachians you'll find summaries on Appalachian hemlock, northern hardwoods. You'll also find dry, calcareous forests, woodlands, and glades, but you won't find these same forest types in Minnesota obviously.

Okay. Now that's a very rapid tour of what kinds of information we are preparing for forest managers and landowners, other natural resource professionals, again to come to grips with how is climate change exposing our forests to risk, what sorts of opportunities may come around from climate change, but ultimately the question is how are we supposed with all of this? Okay. How can we respond?

And in a word the forestry community only has one choice of how to respond, and that choice is to adapt. Now adaptation in this sense means broadly taking action to prepare for climate change, okay. And the upshot is that adaptation activities will build upon sustainable forest management and conservation in most cases. There's a lot of win-win opportunities out there, and in many cases much of what we're already doing for forest management might also make good sense as a response to climate change, and I'll get into that here in a minute.

But this issue of adaptation is something that our group, NIACS, is really focused on, particularly in the last year or so. A couple of things I want to talk about today, the first being a set of tools and kind of a

process to help forest managers consider climate change and develop their own customized adaptation plans. I'm going to get into that in a minute.

So this research or this resource that you see here on your screen, Forest Adaptation Resources, this is kind of like our guidebook, our thought-process that is explaining how forest managers can consider climate change and come up with a plan for adaptation. This is kind of a guidebook that was designed for a wide variety of land managers, and a wide variety of goals and objectives can be accommodated with this process. Again, this is not a recommendations document; it's not a simple sort of decision tree where if you put in your forest type and your location, you're automatically going to get an answer on what you should do for adaptation. It's a very flexible approach, and I'll explain why that is in a minute. The other thing that this guidebook contains is what we call a menu of adaptation strategies and approaches for forest management. So when you see this think of two parts; number 1 is a thought-process or a workbook, and the second part is a menu of choices.

Okay. First, to explain this workbook part. So, what we have decided to do in order to help forest managers wrestle with this idea of climate change and come out with a plan to prepare is basically outline a set of key questions. Think of this as kind of like a structured discussion. And we think this structured discussion can be used to accommodate a wide variety of forest types, a wide variety of management goals in order to come up with an adaptation plan that makes sense. And you see here it starts with defining where you are and what your goals are. Second to that is using information from vulnerability assessments like the ones I just mentioned or other resources to assess what are the climate change impacts going to be for your particular place, for your particular goals that you have in mind, what's at risk, or what are your opportunities. Third step then is taking a look back, and doing a kind of a climate change filter on your management goals to decide if there are some that need to be thrown out entirely, there are some that can just be tweaked minorly, and there are some that you may feel totally confident with, and may kind of reinforce the need to stick with those goals after considering climate change. And the fourth step is going to that menu that I mentioned, and actually this is the chance to be creative. Think about your tools as a forest manager, and devise your own adaptation approaches and tactics, and then circling back around with monitoring. What do you need to pay attention to over the future to know if you had any success with your adaptation ideas?

Again, just to reinforce this. We don't think there's ever going to be a really sort of cookbook approach or a list of ten commandments that every manager needs to follow in order to effectively respond to climate change. And that's because if you think about the diversity of values that forest managers have and the diversity of ownerships that exist across our Great Lakes region. You know two different landowners side-by-side with the same forest could have very different goals for what they care about. One may be particularly concerned with maintaining a certain sort of habitat for a certain sort of rare species. Their neighbor may be more concerned with producing a sustainable income, revenue stream off of that forest. And that's not to say that one set of goals is better than the other. You know, there's no way around that that forest landowners and organizations have different goals for the landscape. But because of that they're going to need a flexible and a very different approach for adaptation in order to continue meeting those goals.

So basically what I've been, what we try to do a lot of times is as a first step work with an organization or a landowner to figure out what their goals are and what their attitudes are with respect to risk, and how much change they want to try to incur on the landscape. So if you are managing a particular, you know, a vulnerable species to climate change, but it's highly valuable to you for some reason whether it's a cultural value or an economic value, you may have very legitimate reasons for wanting to resist change. Right? You may want to hold off the effects of climate change for as long as possible in a given place. And that's a valid choice. Now at the other end of the spectrum you may be a landowner or an organization that actively wants to encourage change and promote a different kind of forest that you think will be more likely to be matched to future climate conditions. Not to say that one is better than the other, but those are just different sides of the spectrum. But basically figuring out where you are within this, within that scale will help kind of define your suitable adaptation activities. And then after you decided what your approach to risk and being defensive or more proactive, then there's a whole range of actions that can either be, kinda green hill bunny sloped, to use the ski slope analogy here. They can be kind of your green circle options; these may be things that you're already doing that are already kind of business as usual for your organization or for your particular land management plan. And then at the other end there are likely some double black diamond actions, things that would require a lot of intense management, maybe a lot more money, maybe a lot more time. These would be kind of more intensive actions at the other end of the spectrum. And so there's a whole range of opportunity in here, and there's a whole range of adaptation actions that can fit within this whole diagram. I'll get to some of those now.

So I mentioned that menu. This is again part of that Forest Adaptation Resources document. This is a menu of what we call adaptation strategies, and these were combined from all of the scientific literature and great literature we could find on adaptation a couple of years ago. These are ten still pretty general choices that you have as a forest manager to respond to climate change. These are adaptation strategies. And you can see, if for example, you were adopting a more defensive position towards climate change. Say I want to really maintain my black spruce bog as long as I can into the future because I really care about the orchids that live there. Then I'm naturally going to be directed towards the more defensive end of this menu. So these sorts of activities are going to make more sense to me. And under these strategies we have, you know each of these strategies has three or five or six more specific approaches that fall within them, so you get more detail underneath each of these strategies. Now if for example I was thinking more about being tolerant to change and just trying to improve the resilience and health of my forest, then I have kind of a wider suite of options, of actions that make sense in this menu. And finally if I'm thinking more proactively about encouraging change, then I'm also going to be steered towards a particular set of items on this menu. And so this is a big step of what we do with forest landowners and managers is helping them think through, and connect the dots from this chain of logic where if I know I need to be more defensive, what adaptation strategies makes sense in order to fulfill that goal.

Okay. Now hopefully everything I've just said makes sense, and is kind of sinking in. I think our work at NIACS would still be pretty incomplete if we just left it there, and kind of gave people resources and said 'okay, go use them, go to work'. So the last thing I'm going to talk about today, something we've been



spending a lot of time on over the last year in particular is what we're calling adaptation demonstration projects. And these are designed to provide real world examples of this whole approach and thought process to show how this adaptation stuff can work in action. So we're building right now a network of real-world examples, adaptation demonstration projects, across the eastern US. We don't have any yet in Canada, but maybe that's a possibility. You can see they span the range of geography in the eastern US. This map is already out of date, actually. We have 40+ demonstration projects growing across a range of forest types, a range of ownerships, and these projects are either developed one-on-one through individual conversations and meetings with an organization or with a landowner. Or through workshops or training process, training opportunities that NIACS hosts, and we bring together a bunch of different landowners from within a geographic area and have people bring their own projects and go through this workbook process together. That's another way we have launched several of these demonstration projects.

Again, the point of these is to showcase the flexibility, so that's the flexibility of this approach, the flexibility of this adaptation workbook, but then also the flexibility that each organization and landowner may have to respond to adaptation. This is a big point that we're trying to get across by showcasing this big diversity, that big diversity of action that landowners can take.

So I'm going to take you through very quickly just a couple of these demonstration projects. If you go to our website, [forestadaptation.org](http://forestadaptation.org), you will find short write-ups of several of these. I'm actually behind schedule right now posting more of these case studies up on the web, but that's something I'm going to be working on the rest of this month. So you'll see more up there soon. So, again, just to give you a brief tour of what are some of these demonstration projects. How have different organizations picked up this idea of adaptation and run with it.

The first I'll talk about is an example from a national forest up in Minnesota, the Superior National Forest. They're working on a project area that is 100,000 acres in a narrow band along Lake Superior, along the north shore of Lake Superior. This is kind of an iconic landscape for recreation, for kind of its aesthetic beauty. It's a huge travel corridor up and down the coast there, and kind of provides access to the boundary waters further north with Canada. An issue they're facing here is widespread decline and mortality of paper birch. So they're trying to figure out what can we do to respond to this decline of paper birch in a way that is also making sense with climate change adaptation? So, just a couple of examples of things that they ultimately came up with as possible adaptation actions. Their goal was to regenerate paper birch, and they knew they wanted to do some underplanting to increase diversity. When we went through the adaptation workbook, they came up with some ideas on where it might make most sense to try to regenerate paper birch. You know, where are they going to have the best opportunity to meet that goal? And then with the planting, which of those species do they want to really favor? Which of those maybe do they not want to put so much energy into? And what are some additional species that they might want to add to their planting mix, either species that are projected to do better under climate change in northeastern Minnesota? So you see these are the, it's not a wholesale revision of what they wanted to do. They're still going to get in there and manage for paper birch, but these are tweaks and things that give them greater opportunity going forward to have a healthy forest.

Okay. One more example that I'll show is from the Menominee Indian Reservation in north-central Wisconsin. So we were working Menominee Tribal Enterprises. They manage a large forested reservation. They have a long and very impressive legacy of forest management, and they also have a very diverse set of cultural and economic goals for their forest. The situation here is that they'd been responding to an ongoing oak wilt problem over the last couple of years on their reservation. When oak wilt gets into a northern hardwood stand, basically you have to, the only way to treat it is to go in there and remove the entire infected tree as well as several rings of trees around those infected individuals. You have to remove the stumps as well; sever all the roots. So you get in there and create these pockets of heavy disturbance within the forested matrix. And this is ongoing work for them. They are already in there and treating these oak wilt pockets. The reason they wanted to work with us was to think about what are some possible climate change adaptation actions they can take on top of this to make this oak wilt treatment more adaptive or give them better future options. So they're picking now some of these oak wilt gaps that have good access and that are good opportunities for demonstration sites, and they're planting some new southern species that occur just a couple counties south in Wisconsin. They're very close to the tension line between boreal forest and more temperate forest biomes in Wisconsin. So they have a lot of opportunities to pick up some southern species. Some of those oaks that are not susceptible to oak wilt, and also to allow some natural regeneration of species that are poised to do better under climate change.

Just in the interest of time, I'm not going to mention these last two examples in much detail. One is with an aspen management project in the Ottawa National Forest where they basically reinforced the win-win opportunities that they have for doing aspen management. One of the things that they were already planning to do that makes sense with climate change, and how can they communicate that to their public. And then finally an example from the northeast. We're working with a group called Atlas Timberlands Partnership to think about what is their operational window going to look like in the future. Much of their forest is traditionally areas that you would harvest and manage only in the wintertime. Those conditions are probably going to be less suitable in the future, so they're thinking about what sorts of planning and infrastructure investment do we need to make in order to make more of these areas suitable for summertime harvest. Can we start testing some of those summer harvest opportunities now?

Again, go to our website. You can find out more information about these demonstration projects. And we're always looking to launch new demonstration projects, so if any of you out there think 'boy, I'd really like to pick this up for my organization or for my own land', please get in touch. We're looking to build this network as large as we can.

So, some final thoughts. Again, please visit the website. Learn more. Get in touch with questions. And if you're interested more particularly in a certain part of the landscape, please get in touch with my colleagues. They're all friendly people. They smile like this all the time. So that's what I have. I would love now to open it up for questions.

Great! Thanks, Stephen. One question that we did have, and you just answered part of it, but I just want to make sure that everyone heard. Who would be the best person to contact if someone was interested in being part of a demonstration project?

You can get in touch with me, and then I may steer you to one of my teammates if it's in a particular landscape that they work more specifically with. But go ahead and shoot me an email if you're interested.

Okay, great. One very easy first question, we had a couple people who had missed the beginning of the presentation and were asking if you could say what NIACS was?

Oh, yeah, sorry about that. NIACS is the Northern Institute of Applied Climate Science. And we're basically like a climate change support center to help all folks across the forestry community deal with incorporating climate change into their work. And we're a hybrid between the Forest Service, National Council for Air & Stream Improvement, Trusts for Public Land, and Michigan Tech University. So kind of a federal, non-federal partnership.

And is there, another question that we had going with that, is are there any particular funding sources that focus on activities for that program?

You mean that we get funding from, or that can help fund adaptation actions? I guess if you didn't write the question you might not know.

I'm not totally sure.

Yeah. So... I would say if you have a question about getting funding to do, to implement adaptation ideas, shoot me an email. There are some funding opportunities out there that can help pay for work like this. And we've been successful at tapping into a couple different kinds of grants if we work with the landowner or an organization and take them through our adaptation workbook. Work together on that. Then they have a really nice story of 'here's our issue, here's our goals, here's how climate change affects those goals, and because of that here are the adaptation actions we want to take'. It's a really nice, you know, it's a really nice way to connect the dots on your logic. And we've had success putting that together in grant applications.

Okay, thank you. Another question, just real quickly dealing with NIACS, is there a southern state equivalent to NIACS, do you know? We have listeners that are in the southern part of the states.

Yeah, that's a good question. I'm not sure if there's an organization in the Forest Service that is exactly equivalent to us, but there are, we do have colleagues in the southern states that are working on climate change information and adaptation. And, for example, the Eastern Environmental Threat Center is one, and I could put you in touch with those folks if you shoot me an email.

Great. One last question dealing specifically with NIACS, and then we'll move into some of the other questions. Does NIACS work with industry in the forestry sector, and if so could you mention some in the GL region?

Yeah, so... Forest industry is, obviously a very big player in the GL region, and they're going to be essential for ultimately helping sustain our forest ecosystems under climate change. Even if we came up with all of the best ideas for here's how we need to adapt our forest. Well guess what, somebody's got to do that work. And in a lot of ways that work only gets done if there's a healthy and vibrant forest industry to get in there and manage forests. Now we also wanted to draw industry in, their perspective and their experience for the vulnerability assessments we worked on. So in each of those places where we're doing vulnerability assessments, we made sure to have a couple industry folks on each of those expert panels. And then we're also just starting to get a couple, kind of a couple early adopter types to work on adaptation projects together. From the forest industry side we have one example in Minnesota with kind of a larger private landowner that they're kind of a vertically integrated forestry company. They own forest land. They manage their own sawmills. So we're working with them. That group I mentioned in Vermont is kind of a, they're a conservation-owned forest on something like 28,000 acres, but they're specifically set up to be a working forest. It's a partnership with the Nature Conservancy. So yeah, we're starting to dip more into that and we would love to get more involved.

Okay, thank you, Stephen. One question we had, and this may be in reference to slide 18, will these vulnerability assessments attempt to embrace IPCC new scenarios under AR 5 report, and if so what approach is being taken to incorporate this new approach?

Yup. So this is... Just to explain the question, these storylines that I mentioned for greenhouse gas emissions. The B1, the A1FI that you see here. Those were created by the IPCC, gosh, more than a decade ago. And we've been, you know the international community has been relying on the same set of storylines for the past several years. The IPCC just for their latest assessment that's going to be coming out shortly has put together a new series of narratives, a new set of scenarios. And we haven't, just to answer the question quickly, we won't be incorporating those new storylines into these assessments. This work was started and the modeling work was underway before those new scenarios were released. We are interested to learn how the new set of emission scenarios compares to this set, so we might be able to do some easy sorts of crosswalks. But this work was already in the pipeline before those new scenarios got published.

Okay, thanks, Stephen. Another question we got was could you walk us through the planning exercise where alternating dry and wet years in succession are a future reality, and the best way to deal with uncertainty of extremes?

Yeah. So we... How to walk through this... This is one of those things that just the variability year-to-year of precipitation, we've already sort of started to witness that in the past decade. And that year-to-year variability is certainly predicted to continue under climate change, and perhaps increase when we look at more episodic precipitation regimes. So one of the fundamental ways to try to grapple with that uncertainty is to think about what can I do to manage my risk across a wet year and a dry year? And so we haven't had an adaptation project that has looked at this specifically, but we have some of these defensive strategies make sense, particularly if we're thinking about that black spruce bog that I mentioned in northern Minnesota. Okay, so those kind of lowland peat forests are really adapted to kind of a narrow range of water table levels, and kind of a particular hydrologic regime. In many cases

there are already impairments. There are already obstacles that are getting in the way of their normal hydrologic functioning, so culverts that are missized or misplaced, roads that cut through peatland, things like that. And so in many cases getting in there and doing some restoration work to sustain or restore that fundamental hydrologic functioning of that wetland is a good way to try to build the resilience of that site and make it more able to accommodate a wet year or a dry year. So this is one of those win-win opportunities where restoration can also be in line with adaptation because in some ways restoration is improving your resilience and your ability to tolerate change. I hope that made sense.

Yes, thank you! A couple other questions we had. One was are there any vulnerability assessments available for swamp tree species?

Without knowing what species you're talking about in particular, I will say that generally yes there's a lot of information available. So if you're talking about within a particular landscape, get in touch with me and I'll point you to our vulnerability assessment because each of these assessments has a whole series of modeling results, species by species. So you could look at how a given species is projected to do under that range of climate change futures. And then I think most of the assessments that we are putting together deal with lowland or swamp communities as the distinct forest types. So in each of these assessments I think there's probably an overall picture of whether those, whether that forest community type is highly vulnerable or not so vulnerable to climate change. And then if it's a species that isn't included in one of those assessments that I mentioned, there are tools like the climate change Tree Atlas that have a big laundry list of species, some of which weren't considered in any of our assessments. They look at something like 140 individual species across the eastern US. So we could probably find that one you're interested for in that tool.

Another question that we got was do we understand enough about how forests respond to climate, or if not what areas of research are still needed? I thought this was a great question.

Yeah. So I will say that we have areas that we are more confident in. And those are, you know, when many different models and literature from a variety of disciplines all point to potential declines or potential increases for a given species. Then that really lends support to whether that species or forest type is vulnerable or not vulnerable. Maybe it's a potential winner under climate change. So there are places where the information we have builds increasing support. Now there are also a lot of areas that are still kind of up in the air. I'll mention two in particular. One is wildfire and climate change. This is one where we are constantly looking for more help and more information because we have kind of a general expectation that in the GL region, climate change is going to predispose us to having more active fire regimes, more potential for increased wildfire. But so much of that, whether that will actually play out depends on future uncertainties like our wildfire suppression policies, and whether that fire may occur as ground fires, etc. So there's a lot we don't know about wildfire.

I'll say the same thing about water table levels. So we have projections about temperature and precipitation, and we can put those two together and think about how that will change our moisture balance in terms of evapotranspiration and respiration from forests. But I haven't seen a really good

model or a way of piecing that all together and looking at what does that mean for water tables, and how does that interact with soil and water.

Okay, thank you. We've gotten several questions dealing with whether or not this could possibly be, this approach could be used on a municipal scale with urban forests or can it just be used in more of a large-scale of forest populations? There are several people who were talking about seeing if there's a way of getting some of this into an urban tree plan that they hope to develop.

I will say that absolutely yes, there is, that makes a lot of sense to try to incorporate this approach into municipal and urban settings. And I would point you folks who are interested in that specifically to email my colleague, Leslie Brandt. She is leading this urban forests project. Specifically I'll mention they're having a pilot landscape in Chicago, but I'm sure she'd be really interested to learn what sorts of questions folks have out there, and if there are opportunities to get in and do some other demonstration projects with some of you.

Okay, thanks. One last question because I realize that we are past one.

Sure.

We have several people that were talking about private forest owners with a small tract of land. Is it okay to not really have a specific management goal and to basically just have planning be let nature take its course? Is that a problem to do?

Uhh, well... Well if you have no goal and your plan is to let nature take its course, nature will take its course. And that may have to do with climate change; it may just have to do with ordinary aging and succession of your forest. And, you know, that's neither right nor wrong. We will have some opportunities across the landscape, whether it's private landowners or say national parks or something where they're required to try to keep the status quo, and they have more a hands-off philosophy. Those sorts of ownerships may be opportunities to these sorts of controls, if you will, for a lack of a better word, but that's also an opportunity to learn. So I wouldn't say that it's right or wrong, but you want to think about, take a step back and think about what is it I really want; what is it I really enjoy or value from my forest? You still may hit on some things that are values that you want try to protect, and that still may steer you to some adaptation actions that may surprise you. For example, if you're really concerned with just maintaining a forest, you want to have a forest there, you don't want it to be a grassland. Well, then you may have a wider opportunity for playing with species over time, if you don't particularly care what kinds of trees you have just so long as it's not grassland. Or you may learn that there are some particular pieces of landscape that you really value, and you want to try to protect. And so you may come up with some adaptation actions that are specifically designed to help sustain those values that you have for as long as possible.

Okay, well thank you, Stephen! This was really great. I really appreciate all of the fantastic answers to the questions. We are out of time, so I hate to say that we have to close our question-and-answer session. But I did want to thank Stephen Handler of the Forest Service for his willingness to talk with us today about his work within the climate change response framework. It was really an excellent

discussion. Also, thank you to Ohio State University, National Sea Grant College Program, and Ohio Supercomputer for funding this webinar. I also wanted to remind everyone that our survey url for this webinar is in the 'chat' feature, so please take a few minutes to fill that out. I also wanted to refer you to resources and an archive of all previous webinar presentations, which are located on our [changingclimate.osu.edu](http://changingclimate.osu.edu) site, as well as our new regional site at [greatlakesclimate.com](http://greatlakesclimate.com). Anyone needing an attendance certificate, please send out an email to us after this webinar and we'll have no problem sending one to you for professional development purposes. This webinar series is sponsored by The OSU Climate Change Outreach Team and we'll continue next month with a team of NOAA experts discussing historical weather trends and a future forecast. The registration is up in the 'chat' feature, so feel free to register for that. Thank you again, Stephen, and all participants on this webinar. We hope that this was beneficial, and hope you'll join us again in an upcoming webinar. Thank you, and have a great afternoon! Thanks again, Stephen!

This was a lot of fun. Thanks for paying attention, and please shoot me an email if you have other questions that didn't get answered.

Thank you so much!