Welcome to our first webinar of this academic year entitled NOAA Climate Rescores. These Webinars are an initiative of the Ohio State University Climate Change outreach team a multi departmental effort with in the university lead by Ohio Sea Grant, Offices of Research, Ohio super computer, OSU Extension and eight other OSU departments to help locate the climate change issue for Ohioans and Great Lakes residents. I am Jill Jentes Banicki from Ohio Sea Grant and Stone Laboratory and joining me today are two experts within the National Oceanic Atmospheric Administration, Doug Kluck and Deke Arndt.

Doug Kluck is the Central Region Climate Services Director for NOAA. He has worked for NOAA since 1992 with the National Weather Service and the National Climatic Data Center. Doug's region covers 14 states from Colorado to Michigan where he is responsible for coordinating and informing on climate service activities among federal, state, tribal, academic, and private interests in the region. Engagement with those groups and interpretation of climate information monitoring, directing research, and education and outreach all central parts of his activities. During extreme climate events such as drought and major flooding, Doug coordinates information response, attribution, and assessment among core partners. We're delighted to have him here today to talk about some great NOAA resources.

Our other speaker is Deke Arndt, Deke has served as the Chief of the Climate Monitoring branch at National Climatic Data Center since 2009. The branch is responsible for routine and special reporting of the status of the earth climate system from large global phenomenon like global temperature changes to regional occurrences like drought and weather extremes. Arndt was one of the lead editors for the 2009, 2010, and 2011 editions of State of the Climate Report. We are delight for having him as well! Thank you both for coming to your webinar series.

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 Doug and Deke at the end of their presentation. We have more than 200 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 Doug Kluck from NOAA who will present "What are Regional Climate Services? One perspective"

Thank you Jill and I think your introduction probably pretty much did my entire slide deck here. So I'm going to show a lot of pretty picture and we'll just remember what Jill said how about that? No, just wanted to say thank you very to the Ohio State University and Jill in particular for allowing us to present here today. I'm going to be talking a little bit about some of the work we've been doing for the last three

or four years in terms of climate services, in NOAA and specifically with the National Climatic Data, and you'll see a lot of pictures throughout this whole presentation. Various disasters and climate events and that's purposeful because as you'll see a lot of what we do, a lot of time is spent especially when communities, states, tribes, etc. have these events happen. We learn a lot from them, we often learn what we're not adapted to and what we need to adapt better to in terms of mitigation.

So anyway, on with the show here. So first the definition, one definition, and there are many of these. But one is simply the development and delivery of climate products and services that are on time and spatial scales needed by most decision-makers. That sounds pretty simple, maybe just on the surface, but really there is a little more to it. As you'll see there is a lot more depth to providing those types of information. I won't go into the great detail this slide says, but simply understand that the development and delivery, product and services, and time and spatial scales as well as decision-makers is something we are going to touch on later in this slide deck.

So some of the fundamentals that we've found to be true, across at least the work I've done. Is that to do climate services on a regional and ever local basis, there are some truisms, if you will, on things that we have to keep in mind. One of those is to maintain and evaluate the relevance of the information that we provide. That takes sort of understand what is going on not only currently, but what has happened in the past and what maybe be happening and what people are worried about in the future. So you need to be, we need to be, in touch with what matters to various constituencies and sectors.

We also need to take an approach, an iterative approach with those sectors and those concerns and try to stay away from the one-off we're done we don't need to come back to that particular issue or sector again because we've covered it. We also need to stay consistent with not only our messaging but we need to let people know we're here no matter what the situation is. And I'll show you some examples of how we try to do that a little later.

There is a factor of being reliable and trust, building trust as well, which are sort of key in terms of people actually listening to anything you have to say. The other thing I'd like to stress is that we very much work across time scales. We don't always work at the 20, 50, and 100 year time scales and the future. We often work in the past, present and when we look at projections and predictions everything from 2 weeks all the way out to 100 years. Often is the case with many sectors especially on the private side. They are concerned most about what is going to be happen for example what is going to be in the next growing season, or what is going to happen in the next month or two. So, it's important for us from a service point of to recognize those needs as well.

Again focusing back up on the maintaining and evaluating our relevance, there the problem focus approach understanding the place in history in which you are. In a particular basin you may have a history of flooding you may have upstream downstream contentions you may have many different issues going on. It's good to know that before you walk into a meeting or some sort of engagement with the private sector. We also try to avoid reinvention and build on relationship that already exist and seem to be working. That takes time and experience being in a particular region and having people you trust to relying telling you those things.

Another fundamental is we at NOAA and maybe even we at the federal government, can't do it all alone it's very important that we work with many different constituencies to solve problems. In fact much of the time we are an information source for them to solve their own problems. We don't necessarily say "Hey we can solve every problem you have just invite us to the table," but we try to share that type of information that seems to be relevant to the particular issue at hand.

Leveraging partnerships and networks is a key element for success kind of fits back into this joint solutions, but as you're going to see in a couple of slides there are many different groups that we work with and different constituencies. Again we could not do the kind of work we do without them. Final recognizing capacities, we all have limits even though we don't like to admit them all the time; on time, funding for sure, our experience, and even knowledge. It's important to know what you have to work with in your particular region. And that again a many of these things are not something you learn overnight it takes time and sort of emersion if you will in those local and regional issues.

Here are some of the key services that we provide on a very very broad scale, monitoring, and I'm going to leave this up to Deke to talk about, but monitoring can be anything from well, I'm just going to let Deke talk about that. The other thing that we deal with a lot is data not only the instrumentation of data and putting actual sites to measure the atmosphere and such, but the collect and data basing… and I guess the other thing I left off there is the availability of that data. That's what NCDC's or the National Climatic Data Center's strongest suits in terms of having information available to inform adaptation or inform decision makers. Then the prediction side is another part, we don't actually do the prediction, but we do the interpretation. A lot of that is place and sector based, and a lot of it goes well beyond the prediction, the classical predictions like from the Climate Prediction Center. We value, add based upon the current situation in the particular region, as least that's what we try to do with our partners.

Outreach is a kind of continuing and daily issue, informing decision and making information accessible to them. Building capacity through education, for understanding what the heck we're even talking about and speaking at a level people can understand. Then from the research side of the house, not that we actual do a lot of research, but we certainly try to steer those folks in the applied climate and other areas, in the right direction in terms of what we hear in terms of need.

Linkage back to how leveraging networks and knowledge and our resources across the region is a key service that we provide. In other words who do you contact? Again, I don't necessarily have the answers for everything, but I often know who does. That is one of the services we provide.

So who are we? When I say we, it's not just these six people, but let's say these six guys and gals are the bedrock of the Regional Climate Service as it stands today within the National Climatic Data Center. We have people covering the entire U.S. and you are more than welcome to reach out to any of them on any particular issue. In fact they'd love to hear from you, and if you need their contacts you can contact me or if you know them feel free.

We also work very very closely with the regional Climate Centers. This is where they are, and I hope I'm not going to confuse everybody by all the different regions and groups I show you, but this is the lay of the land in terms of Regional Climate Services. I'm actually in Lincoln, Nebraska at the moment giving

this presentation but normally I reside in Kansas City. In the central region where I am the high plains region of the climate center the Midwestern region of the climate centers are the two I relay on for providing information and data. Then there are, and I actually don't have who this is, but this is the American Associate of State Climatologists Map. Every one of the yellow states, actually every one of the state except for Tennessee has a state climatologist. Again they are part of the Regional Climate Service portfolio or partnership, and they are very important to our success.

I also quickly want to mention the NOAA Regional Collaboration groups these are groups within NOAA that work very hard to get other parts of NOAA to work with each other and those groups I just showed you before that as well as others, and here are their regions as well.

Finally there are the RISA, the Regionally Integrated Sciences Assessments, you'll see that much of the region that the central region that I'm in actually doesn't have that except for the great lakes and parts of the west and western waters assessment group, but we're working on that to enhance those. So these are groups, this is a NOAA funded group as are the Regional Climate Centers.

In terms of the key federal partnerships, and first I'm going to apologize I'm only going to show a few of these, but these are sort of the ones I'm sure you've heard of before that are very focused on climate related issues and groups we rely on a lot of information and direction. There is the Landscape Conservation Cooperatives under DOI, the Climate Science Centers, as well as the new USDA Ag Hubs. All these have very strong climate related programs associated with them and we all have niche parts in our work of great collaborative with all the federal agencies we work with.

This is just a diagram showing what climate resources, I don't have all the states, tribes, or academic groups, but it gives you a round out picture of who we deal with and what we deal with in terms of federal agencies.

The next part of the presentation is some of the examples of the things we've done in the last few years in terms of products and information, important for at least for the central region. One thing that we do is a monthly webinar to update folks, to summarize the latest climate information, as well as look at the future mainly from a seasonal point of view. We don't monthly look at climate change issues to much, but most of the time it is issues particular to flooding, drought, and unusual climate events. And to give some heads up and some early warning to potential issues in the future. A number of presenters and partners help us with these including the State Climatologists, National Drought Mitigation Center, Regional Climate Centers, USDA, and LCC. They've been a very popular series kind of like this on.

This is a little bit more about these webinars, and I did put in how you can link-up to them. They are once a month, they follow the Climate Prediction Centers prediction every third Thursday of each month. These were started as a response to the 2011 flooding in the Missouri Basin when there was a lot on concern about 2012 spring being just as wet and just as damaging, and having infrastructure issues. There was a lot of worry up and down the Missouri Basin, and so we thought we would provide whatever information we had to help with that situation.

The other thing that we publish, is across the country, are the Quarterly Sub-Regional Summary Outlooks. In the particular case for the central part of the U.S., we do three. We do for the Midwest, the Missouri Basin, and the Great Lakes. All these are fabulous collaborations with a number of different entities. In case, in the Great Lakes case we actually work with the government of Canada to produce a cross-boundary view of the Great Lakes region and basin. They are all available at the URL at the bottom. They just got updated yesterday so you can find the latest quarterly summaries there, and that will say something like September 2014 on them. I guess I won't go into great description about those, but they are meant to be used to provide information to decision makers, not necessarily climatologist, we try to use as plain of language as we can to communicate the highlights that have happened over the last season. What the current trend is in terms of how hot or wet it's been or cold or dry it's been in the particular region in question and then we talk about a little about impacts from those climate events over the last three month, as well a short section on the outlook for the next three months for that particular region.

One thing that we are soon going to be putting on-line is, and it was developed within the last week or so this was finished I should say, for the same three areas Missouri Basin, Great Lakes, and Midwest is an El Niño impacts and outlook summary. Every time there is an El Niño or and La Niña for that matter, we tend to get quite a few question about what that means for us. This is one way of alleviative, teaching, or educating folks what it does mean. There is a myth busting section on the back. People assume that El Niño means something or it may or may not. We'll be distributing these soon, if anyone is interested in that we'll try and make sure they get a copy or get you a URL.

We mentioned this earlier in terms of assessing and attributing, and Marty Hoerling was actually on this particular webinar series talking about how they do attribution to particular extreme events. Here's to cases or examples; the one on the right is in response to the 2011 Missouri River Basin flood and it is an attribution of what cased that. They do a study to understand how much climate variability verses climate change verse random particular events are. The one on the left is for the drought the following year after 2011 was the 2012 drought on the heels of the 2011 flood. There are other ones too, again there are places to go and find these I included the URL's in case you wanted to see them yourself.

This is also that's going to becoming out in the next week or two. Thanks to our many partners but mainly the National Drought Mitigation Center for actually putting it together and doing Yeoman's work and contacting the 14 states. This 2012 drought assessment is mainly for this particular region, that's the central region or north central part of the U.S.

We also do incredible amount of engagement and interacts whether it's on the phone or in person. This is something that actually happened last week in Rapid City, SD. It was a National Integrated Drought Information System sponsored, which is part of NOAA NIDIS is, looks as drought and climate extremes if there are climate events, and tries to help organize information for different groups in different area of the U.S.. In this particular case it was the Missouri Basin that we're focusing on and the 28 tribes in the basin themselves. We had a very good turnout at this meeting with many of your tribal partner as well as federal, state, and academic. That's an example of the type of interactions that we do and engagements and it usually leads to really good things.

A little more about NIDIS, we also held a meeting in February, more of a kick-off meeting for the Missouri Basin in terms of drought, early warning systems, planning for drought, and mitigating drought. This was a kick-off meeting for NIDIS in the Missouri Basin and there is a link if you want more information. NIDIS Piloted Area in case you were wondering where they are. The main one in the region I work is the Missouri Basin Pilot which is just underway.

Just to give another central regions specific service example, we work a lot on other issues. Sometimes internationally with Canada the North American Climate Services Partnership is one of those. We work closely with federal agencies. We have created a Missouri Basin Federal Climate Collaboration. There's also something like that in the Midwest. Obviously a lot of National Climate Assessment type information is disseminated though us, and always doing a lot of information delivery via interpretation. Synthesizing per audience, and what I mean by that is, if you're talking to a bunch of agriculturists, say at the producer level you may direct your presentation in a very different way than you would talking to a number of urban type folks.

That's about all I have, and more disasters here all of these are in the central region. But thank you very much.

Thank you Doug, a great presentation and we have some great questions but we'll hold off on those questions until the end of Deke's presentation. Now I'd like to introduce Deke Arndt from the National Climate Data Center who will be presenting NOAA's Climate Monitoring Services.

Thanks a lot, Hi everybody I'm Deke Arndt, I'm a small part of the Climate Monitoring Branch which is a small part of the Climate Monitoring that goes on at NCDC, which does some of the climate monitoring for our parent agency NOAA, which does some of the climate monitoring around our country. So as Doug mention when you get involved in climate services you have to get involved with a lot of partners. So I'm going to speak more towards the National Climate Data Center or NCDC's efforts in climate monitoring, and what we do and some of the philosophies that we take and hopefully some of the products you might be able to use yourself in your work or your research.

Quick commercial for NCDC, wonderful place, we work with a lot of people I adore on climate monitoring and just taking care of all the worlds' weather data that comes into this building. So when you see the weather person show the weather map with the numbers and observations on it. Eventually those numbers end up there in Asheville. The world's largest meteorological and climate data center. We've been in the Asheville area since the middle of the 20th century.

Just quickly Doug mentioned so many different types of climate services, I'm going to focus on one, Climate Monitoring and what exactly is that? Simply put, if you think about a baseball game, climate monitoring is a combination of the score keeping, the play by play, and the analysis and statistical analysis of the climate system. So when you think about a baseball game you think to do this you've got to know the game. People when they sit down to watch or analysis a baseball game they have varying needs. They either want to hear the play by play, they want to hear the analysis, they want the stats, or they just want to score. And monitoring kind of tries, to do that for the climate system, and what we'll talk about in the next 12-15 minutes or so is some of the way we try to address these needs, that are

listed on the slide. How do the numbers reflect the overall game? What is the score? What are the statistics? Where is the ball? That kind of stuff relating to climate.

Going to talk a little bit about the spectrum the tensions, in a climate monitoring as a service we serve both a science type function and an assessment type function, and a decision support. Real people using real data every day to help analysis their own business practices, and we try our best to support these two different communities and all the community in between. This will come out in the products and services we highlight. There is a real need for the quickest data possible, but there is also a competing need for the most precise data possible. These types of decision that we fact on here, and Doug mentioned the spatial scales and time scales, and how we get these observations. These are the kinds of things we try to integrate in climate monitoring service.

With that now we'll jump straight into kinda what we do. That first tension was the needs of our climate science and then the needs of our larger economy. We support both of these; we'll focus on the second. Quickly how we support the science. Climate monitoring helps with the verification and assessment of the state of the climate. How is the system evolving over time? What kind of climate variability and climate change, and just climate features themselves are occurring on the planet? It really helps us evaluate having this validating data, it helps us evaluate what is our understanding of the climate system as well.

We work a lot with that community we won't focus a lot on that today, we'll focus more on our products and services that go out the front door towards the larger economy. We help hopefully support decision and analysis out there in the real world. It helps to market, and better understand how climate is affecting their own spreadsheets. So when they take our numbers or our analysis and compare it to what has happened with their business. Weather is a huge part of our lives it drives many of the things we do. It also drives a lot of the economic decisions we make. So the products and services and data that we can arrange and provide to those folk is an important driver of what we do. In many ways shapes the projects, products, and services we work on.

Last slide with the science, one of the most fun interactions we have with the science and climate assessment community is through the Bams "State of the Climate". This is an annual report published through the bulletin of the American Meteorological Society. It hits dozens of what are called central climate variables, all over the world on land, air, oceans, and the frozen parts of the world. It assess how is the planets climate system evolving. This fits within a larger body of these types of assessments like the National Climate Assessment and the IPCC. This is the annual physical of the climate system that informs those even larger assessments, and is available at http://www.ncdc.noaa.gov/bams-state-of-the-climate

Operational Climate Monitoring which is about compiling information that helps people understand what's going on around them in the climate system. Putting up a fictional story, and if you were to read through bullet points on this slide. Starting with the "I was driving at a certain speed, 41 mph," that is a fact but without those other bullets it really means nothing. If you read down as it builds context this story gets a lot more horrible as you go from top to bottom. But all of those facts together provide the

context for what is going on, and climate monitoring faces a similar struggle. So transitioning and keeping this story in mind where "I was clearly driving at a speed that was measured", that a speed could be compared to some baseline speed the speed limit in this case. Some of the impacts and context of what was going on in this story; they basically taken together mean a lot more than they would individually.

So the climate and climate monitoring is the same way. If I were to tell you that the first eight months of 2014 the annual global temperature was approximately 58.5 degrees, it wouldn't mean a whole lot to a lot of people. But if we were able to add some context; well based on what we know about the 20th century this is about a little more than a degrees Fahrenheit warmer than the 20th century. Then you a least now know we are on the warm side of history, at least the 20th century. And if I were to say, that's the third warmest value that we have observed this way, then that really starts to give you context. The first eight months this year, and all these facts are true by the way, first eight months of this year was ranked third out of some group of years. Oh well, that's a 135 year record so that helps you put that into context. Then adding another fact, this was the 354th consecutive month, August was, that was warmer then it's 20th century average. So these facts together is a very very very scaled down simplified version of what we try to do with climate data and turning it into useful monitoring information.

Here's that exact same set of fact but put into a graphical context. This happens to be global temperature probably the most prominent global variable we track especially in terms of climate change and global warming. 2014 through August is way up there on the top; one of the facts is that if we continue with our current 1.2 degrees Fahrenheit above normal or about .7 degrees Celsius above normal. If that holds for the next four months we will eventually have the warmest year of this 135 year record. So this graph shows each year from 1880 on the left to 2014 on the right, the blue crosses are the individual years. If they are above the dark line they were warmer than the 20th century average. If they were below the dark line they are cooler then the 20th century average. You can see some things in this graph; this graph pulls out even more context of this global temperature record. We can see generally an increase with little ups and downs along the way. So one way we try to contextualize the data is turn data into graphics. So people don't have to do that themselves, so they can take a quick look and assess what they need to assess. And this data was available through our Climate at a Glance tool and the URL is http://www.ncdc.noaa.gov/cag

What makes good monitoring? The first thing we need to do is report what happened. Report that I was driving 41 mph or the average temperature so far has been 58.5 degrees Fahrenheit, and then provide some context. How different is that from some baseline? Is that slower or faster than the speed limit, or is that warmer or cooler then the 20th century? Then how unusual is that? That is where that third warmest rank comes in. Then importantly what is the trend? Is this part of a larger trend, is this part of what we've seen in the recent past, and is this part of what we expect in the upcoming future? Then again what are the impacts? So if we can take data and use data to answer those five questions, we're doing a pretty good job at monitoring. We also need to remember variability and how things change and the extremes we experience. We always need to remember to be able provide the data and the history of that data to people that want to dig into the numbers that went into our monitoring information.

Monitoring is rooted in history, just like the story about my driving needed some context. The historical record is what provides a lot of the context for our monitoring efforts. So being lucky enough to sit here in the world's largest collection of weather and climate data allows us to really explore as much of the history as we can and be able to put todays weather and climate into this deeper context. This is the function that is kind of a natural here at NCDC although it does happen all around the country in various offices and Doug mentioned many of our partners. I just want to pause on that last bullet, this historical record is not over stating it, is a national treasure. This has come from generations of people, many of whom that are now no longer with us. Who have taken these observations, and taken care of these observations, and recorded these observations, and stored, and safely stewarded these observations. So that groups mine and groups like yours kind find them and make sense out of them. We are at the end of the pipeline or part of the circle of life of all this climate data. It's important that we always to recognize that.

Alright so same data we just looked at, what does that 2014 purple cross-hair look like when you spread that single value out on a map. These are a couple ways we try to do that. Both of these maps are built on the same historical data. Both of these maps try to show January through August of 2014 in context of history. The map on the left says here is how these first eight months of the year stacked up to the same period average, the normal so to speak, from the late 20th century to 2010. If you take the 1981 to 2010 average and call that normal, the map on the left show how this year stacks up against that normal. Why don't we use the 20th century average for that map on the left? Simply put that how map would be red. When people look at maps they are usually looking at contrast and that want to see how different regions vary from each other. So using a recent period that is almost as warm as what we are experiencing today allows us to provide some contrast on the map so people can compare the eastern United States and Canada, and the relatively cool temperature we've had to the really warm temperatures we've had in the western part of North America.

The map on the right is for the folks that want to dig into the deeper history. That map show for each one of those grid boxes, where does their first eight months of the year compare to their own history. Each grid boxes own history, so where see the darkest red, that gird box has the warmest January through August that we've observed since 1880. As you go from right to left along the scale on the bottom it's the warmest, it's the top 10%, the top one third, the white value is the middle third, and as you go cooler on the cool side, it's the coolest third, and the coolest 10%, and the coolest on record.

That's what we've seen so far, that's something that we reported; the URL is on the bottom, (http://www.ncdc.noaa.gov/sotc/global) theses global temperature and the global analysis comes out around the 18th-21st of the month, and it's available so we just released that last week. The August 2014 Global Numbers.

So what's that mean in the USA, we already eluded to the fact that this was a very cool summer and the year to date in the eastern half of the United States, and it's been really warm and dry in the western part of the United States. The analysis, the numbers are all available at the URL below (http://www.ncdc.noaa.gov/sotc/national)we release the US report around the 8th-11th of the following month. This is the same type of graphic, it puts the temperature that were observed each summer

compared to that regions own history. So parts of California had their warmest summer on record. Parts of the Mississippi Valley had a bottom 10%, a coolest 10% summer on record.

What makes an average? So an average temperature is an average of the high temperature and the low temperature of the day. One thing that is really interesting when you break out that same summer that we just looked at. And we compare the high temperatures from the summer, the afternoon temperatures so to speak, they were quite cool throughout most of the US. But when we look at the overnight lows just form this summer they were quite a bit warmer. That is constant meteorologically with the pretty wet summer through most of the country. But each of these maps means something different things to different people, and different industries. The energy industry is very concerned with that map on the right because the warmer summer nights are the longer that people leave their air conditioners on. That's more eclectic demand, more energy demand, and so it's a bigger tax on the energy infrastructure the summer nights are warm. Also if it's very warm pretty hard on agriculture. On the flip side the afternoon temperature were delightfully cool throughout much of the Midwest and Mid-south. The corn crop is coming in great this year because there was not a great deal of heat stress on that crop. The afternoon evaporation demand wasn't as high. Again breaking out that average temperature into two different pieces that mean different things to different industries, is part of our responsibility that we try to meet each month.

Then we try to take raw meteorological data and combine that into things that are more meaningful to societal impacts. This is an example of some of some of these societal impacts, variables we have. This happens to be a graphic of summer, estimated summer energy demands from residential areas based on where people live and where the summer temperatures were. You can see that in general with a lot of little wiggles up and down, as far as residential energy demand it has been growing due to the climate of the United States over the last few decades.

Extremes are also important, and this is really where we are trying to focus a lot of our new energies in the future. Though we have, and I won't diving into the details of each of these indices, but some of the things we do here at NCDC, both within the climate monitoring branch and in other parts of the building. Are examine how are the big events changing? The graphic on the left is a part of our Climate Extremes Index that looks at how much of the country experienced really warm or really cool temperatures over time, and you can see over the last few decades we've been, more and more of the country has been dealing with warm in the first part of the year of the year. But you see 2014 really sticks out there at the end of the graph a big chunk of the country dealt with these really cool temperatures. This index tires to, with mean like that, tries to examine how the big events are changing over the United States. Billion Dollar Disasters, which is a combination of weather events, where they happen, and the value of the things they beat up are all part of the mix for Billion Dollar Disasters. We can see generally though changes in weather events and where they happen and the value of things weather event impact we see more billions dollar disasters in recent years, and in the late 20th century.

As Doug alluded to, time scale really matters. We are coming around the bend we are about to the finish line here. This is a graph we call a "Haywood Plot", it comes out sometimes with our US monthly reports, and this is for the city of Wichita Falls, Texas. The bright blue line is the rain that they received

from June 1st on the left to August 31st in the right of 2014. The dark grey line is how rain would on average accumulate over the course of the summer. It was actually a pretty wet summer. Slightly wetter than normal summer, 2014 that blue line riding above the grey line for much of the summer meaning they were ahead of the curve. They are wetter than normal for much of the summer, and that's great for the fire people, but if you look at the year to date, that wet summer took place in context following some really dry months. So for the year to date that wet summer hasn't caught them up to normal yet. You can see the blue line 2014 still not up to normal, about 4 inches below normal for Wichita Falls. Then time scale really matters if you expand that out to five years. The grey line would be the average precipitation you'd expect to accumulate over 5 years, and you can see that the last five year have been the driest five year period in the modern history in Wichita Falls, Taxes. This summer wet summer has done little to help that out. Wildfire folk they don't really care about that, if it's well rained in the last few days that tamps down wildfire danger of a few days.

Reservoir managers, the people that are in charge of getting water and having enough water they really really care on this longer time scale. Part of our responsibility is to understand that different folks have different sensitivities to different time scale, and provide the kind of data they need.

Finally who uses this? We had some late reports earlier this year for some logistical reasons. These are the types of folks that we heard from. We expected to hear from the meteorologists, and they would say when is your data coming? We also heard from a lot of companies that monitored their retail sales patterns. We heard from the finance industries who were monitoring other companies' retail sales patterns and commodities. We've heard a lot from big Ag a very traditional user of climate monitoring information. A lot from energy, and then of course many of our partners in the public sector that we share data with and that rely on our services as well.

Finally, drought is an extreme it's a combination of temperature, precipitation, and water demand. I just threw this on here it's an example of one thing we participate in climate monitoring. As Doug said this is led by a multitude of different institutions and we are just one of those. This is a weekly assessment of how bad the drought is across the United States and Puerto Rico as well. The point of that is, it really takes a village to get all this information together. No single observing system, no single institution, no single approach, help everybody. Climate is complex, people are complex, the society we live in complex. So we really rely on these partners, and it's a shame to put them in the bottom two thirds of a slide because these folks down here are a big part of what we accomplish together in getting good climate information out there to the country.

Finally drought.gov happens to sit the US drop portal is the public face of the NIDIS program that Doug mentioned earlier. It sits at NCDC also taking advantage of this great stockpile of this data, and how can we put today's drought in the context of the historical drought that we've seen. So one of the things that they are working on is getting a gridded Standardized Precipitation and Evapotranspiration Index, to basically one way to look at drought. They are working on ways to take advantage of upcoming gridded data sets. So that they can lay this data out there and people can see on a finer resolution what's going on. The data that's actually available through drought, there working on how to map this.

That brings up a good point, as we go forward; satellites are going to be way more important in what we understand and they have real strength. This is another one of those tensions. These in-situ records these weather stations around the world. Have been there a long time and we know exactly how they'd behave over time so we can get a lot of really great historical information from them. But the satellite information is available quickly and it's available across the broad region and we are trying to find ways to blend the strengths of these two data sets. This is not just NCDC this is the whole climate monitoring community. It's working on taking that strength of that historical record, and marrying that to the strength of remotely sensed data, big effort here and NCDC as well.

To wrap up, you know, what makes good climate monitoring? Is being able to say definitively what happened, this is how big it was, how different is that from some baseline, how unusual is that, is this part of a trend, and then what were the impacts. We rely on our partners around the country to help us define those impacts.

I'll stop there, I'll leave this slide up, this is where you can get some of the information we just showed, and turn is back over to Jill.

Great, Thank you Deke. We have a lot of great questions. So let me just go through, I'm going to start with questions that we got for Doug and I guess feel free Deke if there's some things you can add to any of Doug's responses, feel free to jump in, and Doug you are unmuted right? You're good?

Only if you can hear me now.

Yes you're good. OK.

One question and this probably is for both Deke and Doug. Even though historic weather data is available in each state, it's difficult to compile and analyze lack of research, resources, and funding. Does the NCDC provide this support?

Go ahead Deke if you want to start.

You bet, so we have an entire group of people that are, their foremost mission is help people find the products and services they need. I'm sorry I don't have the contact information, but if you go to that top URL and you will find links to help find climate information. Both the monitoring products and the raw data, and there are a number of automated services as well within NCDC's website. So the short answer is yes. There are both computer applications and more importantly there are trained professionals, meteorologist that can help you can get to the data you are looking for.

Another question that we got was, and again this might be for both of you. It's rather difficult to short through all the information related to our potential resources. Is there some sort of PDF of contacts, or a single go to person, if someone would like to dig up a climate statics such as number of extreme rain events in a certain area?

Yes, so it really depends on the question of course what the answer is going to be. I think in terms of finding individual answers for very specific question like that last one. You can go through the NCDC or

there are the regional climate centers too. I would say one good way to do these things is through Google. Not necessarily asking the question that way, but finding who has that data might be one option in terms of doing that. Deke do you have anything to add.

No, I would just say these times of Google era tools are, our data access branch is actually working on improving that, and helping to providing key words and basically really facilitate people finding the static or the particular data set that they need. It's an ongoing process. The world is changing really fast in terms of technology and they are racing to keep up with it.

Thank you, a couple questions from Deke's presentation. Deke is there a standard precision for weather parameters that the NCDC keeps?

That's a great question so, yes, so and that also depends on the scale, both the time scale and space scale. Most weather stations for example and if we just use temperature for an example, they usually measure to the whole degree. Most of the stations that we get; we get a high temperature that is rounded to a whole degree, and a low temperature that comes in as a whole degree. Thankfully for the same reason that a quarter back's yard per attempt, passing average, you can, you know since each pass a quarter back throws is measured in whole yards, but if he throws enough passes you can say that Tom Brady throws for 12.25 yards per attempt. You can do the same thing if you aggregate enough weather data as well. So for national averages, for time scales as large as a month or larger, we will go to a 100^{th} of an inch. For these smaller regions, for states and parts of state we feel confident rounding to an 10^{th} of an inch. Again because we know we have lots of stations reporting over many days throughout the season and we're able to make more precise averages for those areas. For a single station on a single day we're not going to do that. But for lots of stations over a long time with many observations we can use the power of that statistical Central Limit Theorem to come up with these decimal values.

Thanks Deke, we've had a couple question dealing with, would the National Weather Service provide, and would the NCDC provide. And there was one example that maybe I'll just ask and you'll be able to answer and I think probably generally to hit a couple of the others. Our local National Weather Service office says that there's normally about 20, 90 degree days locally, but the NCDC database shows 13, 90 degree days as of the 1981-2010 average who's correct?

So one of things that happens with the Weather Service is in the middle of the 1981 to 2010 period, they really modernized a lot of their equipment and during the course of that modernization some of that equipment moved. So NDCD's values that are calculated take that into account. When we do have interruptions in station data like that. We have algorithms and methods and techniques that we study and publish and then use. In order to come up with these average values that from a climate perspective more thoughtfully approach the whole 30 year period, and what we would have seen if the new station had been in place the entire time. That's part of just the profession of applied climatology is learning how to take these weather data from stations and how to turn them into useful climate information.

Thanks Deke, I would like to ask three more questions if both of you are game. It is 1 o'clock so I just wanted to double check to make sure you are ok if I ask three more questions.

You bet.

Great, alright, thank you. One question that we had, and we actually had a couple dealing specifically about where they can get this type of information. So let me just ask one. Which website or graph is best to see how bad last summer drought and winter cold were in our area? This is from someone who is in the National Park Service that uses your information, she said specifically she had hemlock trees that turned grey and then died over the winter. So it'd be great if she knew where she could get that information about last year.

Deke that sounds like State of the Climate right?

Yeah you bet, so there's a couple resources. Doug mentioned the monthly State of the Climate reports and that is available through the monthly reports link there, but there is a specific monthly write up of the drought phenomenon in each of those monthly reports. There is also data that are associated with it and you can kind of get to that drought data through that Climate at a Glance tool. That is the fourth link on this screen right now. So from a narrative stand point, form just an expert's assessment. Those monthly reports are good they have links to a lot of data. The Climate at a Glance will provide access to various drought indices that you can zoom into parts of your states. Then, and we developed that in collaboration, some of the tools that are in part of that Climate at a Glance with the US Drought portal that works right in our branch. And finally I would discount the monthly US Drought monitor, which each Thursday comes out as an expert assessment of the severity of the drought and they keep an archive of all of those weekly assessments. Again just like Doug and I alluded to this is a community of agencies and institutions that work together every week with hundreds of experts out in the field that are experiencing drought and reporting conditions and impacts. So that weekly drought assessment, each of the categories D1, D2, D3, D4 those are tied with an unusualness or how often we would expect to see a drought this sever. So if you do go to those weekly assessments they keep them online you can go all the way back to 2000. And you can see how the drought evolved; how communities of experts assessed that drought, and how sever it was as well.

Great thank you. Another question, we do a lot of summarizing extreme precipitation event to construct return interval plots. But often the individual extremes are flagged in the record as outliers. What are the criteria the NCDC uses to flag events as outliers?

Hey this is Deke and I'll take that as well. I'm going to give you general answer on this because I haven't been directly involved in the quality assurance process. But the items that getting flagged, first of all the data don't changed they just get flagged as outliers. So the data is preserved and is available to use as long as you just hit that outlier flag and are willing to accept the datum or not. Some of the tests that they run are spatial coherence type tests. How does this value jive with the neighboring stations? Is it completely different than many of the neighboring stations? If so that might trigger a flag. Is the value larger than the climate logical extreme that have been observed for that part of the world as well? Something that I don't think it's exactly called a range test but is basically for that part of the world. Is this really bigger than the expected maximum for that? Again those are the types of test that are going on. Is this outlier in the sense that the variability, you know is this part of a pattern of a number

repeating itself over time. Where a station may be sending out information that is repetitive and an algorithm picks up on that says hey you might want to look at this. So there's lots of little test like that. I'd emphasize that the data are preserved. Their flagged as an outlier and a lot of times, and this is unfortunately but understandably the case with a lot of extreme observations they do look really big. They are outliers even if they are genuine. So a lot of these outlier test will go ahead and flag those conservatively just in case.

Thanks, one last question for both of you. What are federal funding program opportunities of climate change research grants that you can recommend, and also can you be collaborators on these proposals where a climatologist expertise is needed?

I'm going to let Doug answer that one.

Not fair. There are many federal but there many versions, or opportunities out there to look for research moneys. I'm going to try but many of the partners we listed up there have those opportunities embedded in them from a federal side anyway. I guess there are, if you're looking for federal grants there are a particular website to go to, for most federal announcements in terms of grants. I'm not remembering it off the top of my head, I'm sure you can google that too. As far as collaborating, it's possible that we can collaborate as long as it's not NOAA based funds or something related to us. So the answer to that, the caveat to that is, you know as long as it's not something we would be funding. It really depends, how about that. That is my answer.

And I believe that grants.gov is the clearing house that..

Yeah that's really hard for me to remember for some reason. Hey, while we're talking just really quickly. There are three websites that I forgot to put on and they have oodles of information on these climate services and climate information type things. One of them is climate.gov. In fact you can get to a lot of NCDC information via climate.gov. weather.gov obviously if you want weather information you go there. Finally drought.gov which has an incredible amount of information as well, just wanted to mention those.

Thanks Doug, Well I think, we are actually out of time. It's about 10 after so I don't want to keep both of you on too long. Thank you so much for presenting here today we had so many people that really wanted to get more information about NOAA Climate Resources, and you were able to pride that for them. So we really appreciate both you Doug Cluck and Deke Arndt for your willingness to talk to us today really an excellent discussion and excellent questions. Also, thank you to Ohio State University, National Sea Grant College Program, and Ohio Supercomputer for funding this webinar. I did 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 site. This webinar series is sponsored by The OSU Climate Change Outreach Team and we'll host the next webinar October 9th with Daria Kluver of Central Michigan University who will be talking about Snowfall. The registration is up in the 'chat' feature, so feel free to register now. Thank you again, to Doug and Deke, 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 a lot Deke and Doug, we really appreciate it.

Thank you!