

Jill: Thank you all for standing by and welcome to our webinar entitled Mapping and Visualizing Lake Level Changes for the US Great Lakes. These webinars are an initiative of the Ohio State University Climate Change Outreach team and multi-departmental effort within the University led by Ohio Sea Grant Office of Research, Ohio Super Computer, OSU Extension and several 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 Laboratory and joining me today are two experts within NOAA, National Oceanic and Atmospheric Administration, Doug Marcy and Brandon Krumwiede. Doug Marcy is a coastal hazard specialist at the NOAA Office of Coastal Management in the Science of Geospacial Division. He has been with NOAA for 13 years working on flood, sea level and lake level matter assessments and coastal hazards assessment projects contributing to more disaster resilient communities. Also joining us today is Brandon Krumwiede who is the Great Lakes Geospacial Coordinator on contract through the Baldwin Group at the NOAA Office for Coastal Management in the Science and Geospacial Division. He has been working with NOAA for 3 years working on geo-gif and remote projects focused on hydrology and the coastal environment. We're delighted to have both of them here today to talk to us about NOAA's new tool, the lake level viewer. Before we get started a few logistical issues. During our presentation we will be on listen only mode. Afterwards I will conduct a question and answer session. If you would like to ask a question during the presentation, feel free to ask those questions in the chat feature located on the right hand side of your screen and I will collect and pose your questions out to Doug and Brandon at the end of their presentation. We have more than 150 participants on this webinar so far, a great diverse group representing governmental agencies, academia and nonprofit groups from the Great Lakes and from around the country. Please keep those 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 the chat feature located at the end of the hour, toward 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. So without any further delay, I would like to introduce Doug Marcy from NOAA who will present Mapping and Visualizing Lake Level Changes for the US Great Lakes. Doug, I'm going to unmute you. Alright Doug, your presentation is up.

Doug: Okay, thank you Jill. Good afternoon everybody. I hope everybody can hear me well. I'm happy to be here today talking to you about some of the work we've been doing to better visualize some of the potential changes in lake levels of the US Great Lakes. What I'd like to do is just start by going through an outline of what we're going to present to you today and then we're going to go through a series of slides to explain some of the background in climate issues. Some of the Great Lakes climate science and historical water levels. Talk a little bit about the need for visualizing potential impacts and then talk about our lake level viewer, a new tool for the US Great Lakes, how we develop that, talk about, actually we're going to have a demonstration of the web mapping tool. My colleague Brandon is going to do that and then how to get the data and the map services behind the tool and a little bit about our future work going forward.

Those of you that are from the Great Lakes region already know this and some who have visited in the winter probably know it very well. The lakes have a significant impact on the regional climate system. This is a great satellite image showing the five Great Lakes, the large Great Lakes and how they really do impact the weather and the region. This is showing a northwest flow and the clouds and of course lake effect snow bands that do occur in the winter. The Great Lakes have a huge influence on the clouds and they act as a giant [unclear 4:52] and they moderate the temperature and also keep things a little bit warmer in the winter around the Great Lakes shoreline.

This is just a graphic coming from the National Climate Assessment, the third National Climate

Assessment and in the next couple of slides we'll talk a little bit about that. You can see the Great Lakes basin here does impact, the lakes do impact the temperatures and the ice conditions. Over the lakes themselves it keeps the temperatures themselves a little bit warmer. The water again acts as a heat [unclear 5:27]. For the most part, all of the Great Lakes are ice free, except for Lake Erie. That's a little bit shallower and does end up getting covered with ice. Of course that depends from year to year. Last winter a lot of lakes actually had mostly cover, but for the most part, Lake Erie is the only one that consistently gets covered with ice. You can see that also the frost free periods, there are a greater number of frost free periods or frost free days near the shorelines of the Great Lakes and they also moderate the summer temperatures and also concentrate precipitation in these snow belt areas or areas down wind of some of the lakes in summer due to the lake actually stabilizing the atmosphere a little bit and pretty soon less precipitation. As we go forward into the future, you can see that looking at the National Climate Assessment, the third National Climate Assessment which came out in May, there were these regional assessments in the mid-west portion, saw paths of precipitation and temperature on the region. Extreme rain fall events and flooding have definitely increased during the last century and these trends are expected to continue. It's likely going to cause erosion issues, maybe potential [unclear 6:56] agriculture, human health and infrastructure. The mid-west including the Great Lakes will likely experience longer growing seasons and potentially rising current levels will increase the yield of some of the crops and lake ice is also likely as we head into the 21st century and you can see in the graphs here that the graphic average precipitation potentially will change and the heavier down pours definitely will increase in [7:26 - audio cut out] in addition the temperature changes will also be occurring that will have an impact on our ice coverage.

As you can imagine and see from the past few slides, there are a lot of climate variables that impact the water levels in the lake. Climate impacts all of these and it's definitely there's a feedback of change and another one changes. It's a very complex system. [7:56 audio cut out] and ultimately what drives the lake levels is the hydrologic cycle we learned back in kindergarten and that is [unclear 8:08] how much precipitation we get and input from land and ground water versus what gets taken out through transpiration and lake evaporation ultimately ends up with the water [unclear 8:23] and determines what the lakes will do. Looking at the evaporation rate, information comes from the Detroit district of engineers. You can see that evaporation has been increasing as well as the water structure temperature. This goes back to the 60s. This will definitely have an impact.

What have the lake levels done though? You would think that with all these variables and things increasing that I guess some of them are positive and some of them are negative because obviously they affect the water levels in different ways. This is an example of Lake Superior and you can see they've gone up and they've gone down. As a whole in all the lakes, they all vary. Some of the lakes are more controlled and you see less variation, but this is a great graph showing that the variability, obviously there's a seasonal variability and that's the individual bonus, but there's a longer cycle that occurs. The red line through these are the long term average and that becomes important for us later as we talk about how to map these different water levels.

Again, looking at the past National Climate Assessment, the second National Climate Assessment actually predicted significant drops in lake levels by 2100, but the most recent climate assessment showed that the current studies kind of, the previous studies, sorry, over estimated the amount of vapor transpiration so they actually predicted slight increase, I'm sorry, a slight decrease where there might be a slight rise and you can see that they're not consistent in that wording. Partially that's because recent climate studies along with a large spread in existing model results have indicated that projections in the future due to climate changes are still subject to considerable uncertainty and that's just with the climate model. What we do as humans in terms of future development practices, land use practices,

more impervious surfaces and things like that will also impact the amount of runoff that will go into the Great Lakes watershed so there's a pretty complex problem, but that doesn't keep it from going up and down as it has in the past.

In 2013 we had record lows in the Great Lakes. This was from an article we had in the Lake Michigan and Lake Huron, which are considered just one basin, same water level. We had record lows, but as we go forward, we see that currently the water levels are actually higher and have been this past year higher than normal so they do go up and down. The low water impacts are that it can impact the shipping and power generation, some tourism. It's not necessarily aesthetically pleasing to have a muddy bottom exposed with a lot of potential algae, vegetation. There could be some odor with that as well and during low periods, carriers for instance, iron or coal and grain are forced to carry fewer goods because they can't have their draft as much. Also as the levels recede, the marinas will have fewer slips to sell to boaters so it could impact again tourism and be able to accommodate the boaters needs, but when we expose more shoreline, it could be advantageous for the extension of some wetland habitats and there could be some potential positives to it as well.

Obviously with high water impacts, we're enhancing the existing coastal storm impacts we see with seich effect causing bluff and beach erosion. This will just increase where we have high water levels and understanding, obviously understanding these water levels, their distribution and the impact associated with them has been something that the Great Lakes Initiative has really tried to focus on.

This project is funded or was funded initially by President Obama's Great Lakes Restoration Initiative. We feel it fills a critical information gap and we were doing some surveys in the beginning to build requirements for this tool. We surveyed a bunch of folks through funding through the NOAA Coastal Storm Survey and 40% of the survey responders said that the current data on visualizing lake level changes were inadequate and only 26% said existing tools were there. We had a lot of good information and I'll point to those in a second on the water levels and how to visualize the water levels, but not on a Geospacial scale. There's a lot of challenges with mapping in the Great Lakes, especially the Great Lakes shorelines.

First of all, it's a pretty large area. The Great Lakes US side is the side that we're doing right now with this particular project. It's about 4,900 miles of shoreline and this is a great graphic showing how the lakes kind of stack up with the east coast shorelines. It's close to 5-6% of the entire US shoreline throughout the country and that's quite a challenge.

So our charge with developing this tool was to go and use the best available high accuracy topographic and bathymetry Lidar data. Lidar data is data that we'll talk about in a second to build a seamless visual elevation model for the US Great Lakes shoreline. We wanted to map lake levels below and above each lake's long term average level to visualize the impacts of both flooding and low lake levels. Photo simulations at local landmarks to actually see the impacts. Link visualizations to historical water levels, the water level dashboard, which I'll talk about in a second and also define as we go through this mapping process, define where elevation data gaps exist so we can go and collect them in the future. Also and Brandon is going to illustrate this, the access to the map services and the data behind our tool that can be used for shoreline [unclear 14:59] long term change and planning purposes.

So the first thing we had to do was find what's the best available topography and bathymetry data. Luckily we had done some previous work on this in the Great Lakes. We were developing what's now called the US Interagency Elevation Inventory and one of the first places we started collecting this information was in the Great Lakes. So we can see there was a combination of elevation data sources. A

lot of data that we used in this tool are coming from the US Army Corps of Engineers Joint Airborne Lidar Technical Center of Expertise, which is a big acronym called JalTech, but there are other sources including Great Lakes Restoration and Institute of Funding and [unclear 15:47] Lidar and took back the Lidar in the Lake Superior region. So this inventory helped us figure out where is the best available data to be able to bring in and be able to start building these digital elevation models.

A little bit about topography and bathymetry, the Lidar, which is basically collecting elevation data from an airplane based system actually uses laser technology to send a laser pulse down and hits the ground, whatever the water surface or the ground surface and return energy comes up and is recorded by a sensor. It's very efficient because you can do large [unclear 16:30] and you cover a lot more ground with airborne methods versus traditional ship based methods, but that does have some challenges with doing this, especially for bathymetry. There are two types of lasers used to collect topography and bathymetry. Traditional topography based Lidar uses a red laser and a green laser is used for bathymetry and that penetrates the water surface that goes down and the energy can actually hit the ground. I'm sorry, hit the bottom and return. It will produce multiple returns and filter out the water surface. This is based on light, so you can imagine if the water quality [unclear 17:18] is high, then the light will not penetrate and you will not get data and that has caused issues in some portions of the Great Lakes and this just showing our digital elevation models. We do have gaps. You can see on the left slide here. These are the actual raw points. The green are individual points from the topography. You can see some of them are on the land side and some are off shore and you see this little gap area where the interface between land and shoreline is typically very turbid due to waves or whatever and mud and sand, sediment input so we do have gaps in those areas. We're not actually collecting data.

The current data coverage we have [unclear 18:07] released which was last fall, we had mapped approximately 3,800 miles. We still had gaps of about 1,100 miles and we have a digital elevation model for approximately 7,800 square miles and you can see here where some of the gaps still exist and we're still going to be working on. Within that coverage we definitely do have other gaps. We have places where we have topography, but we have no bathymetry most because of this turbidity issues. It's less common that we have bathymetry and no topography. Most of the counties do have topography now and that's filling in quite nicely, but in places where we really want information like in our harbors, for instance this is the St. Louis Watershed area in Duluth. We have the flooding information, but we're missing the water depth information and we're trying right now to go back and fill that in. Brandon will talk about future data collection efforts.

We wanted to connect to the existing water level dashboard as a very popular product at the Great Lakes Environmental Research Lab has produced and this has given us a great perspective on historical levels. We worked with [unclear 19:26] to make sure we incorporate that information from the dashboard into our tool and Brandon will show that and we're also using this long term average as kind of our zero starting line because the water levels go up and down above and below that line throughout the past and will continue to do so.

One last thing about some of the elevation challenges. Obviously all the Great Lakes have different elevations. The water elevations as it goes from the highest point in Lake Superior all the way down through Niagara Falls to Lake Ontario so when we're communicating these levels, we have to use different datums. We try to communicate that in the viewer and therefore we make you sort of select your particular lake that you're interested instead of the numbers in the viewer are relevant to that particular lake so there are some challenges when doing that.

I think that's a pretty good overview and some background and what I'd like to do now I think Jill is

we're going to transfer it over to Brandon. He's going to do a little demonstration of the tool and he's going to finish up with how to access the map services and data and what the future efforts will be.

Jill: Alright. I just unmuted Brandon and Brandon I'm going to give you the ball.

Brandon: Sounds good.

Jill: I wanted to let everyone know that because Brandon is going to be sharing his screen, it may be a good time for people to go to, if you go to your upper left hand corner of your screen, there is a view. If you look for view in the drop down for full screen, that should allow you to see the viewer better. I just wanted to mention that for everyone so they can see a little larger. So without further delay, I would like to introduce Brandon Krumwiede who will be taking us through the viewer. Brandon, you are set.

Brandon: Alright. Thanks Jill. One other note logistically here too. While I hope everyone is excited to explore the tool, if everybody could just hold off during the demo otherwise it might slow things down on clicking on the link until afterwards. Hopefully it won't bog down too much. When we tested earlier it was working fine. Excuse me. So I want to introduce everybody to one of the first jumping off points for lake level viewer and that's the tool page for the lake level viewer on the digital coast. For those folks that might be new to the lake level viewer and want to get some further information, this is a great starting point. It provides an overview of the tool. The other thing as well is there is important information up and there is a lot of frequently asked questions and we try to capture a lot of those in this important documentation as well as describing the methods into actually trading the tool. What type of modeling are you using? How do you define uncertainty in the data? A lot of those questions can be answered through this tool page right now.

So we'll go ahead and launch the viewer here. This is the initial splash screen for the lake level viewer. Again the lake level viewer was developed using [unclear 22:51] funding to provide a viewing tool for the US coastline in the Great Lakes. One of the disclaimers that we want people to be aware of is please do not try to use this for any type of navigation or for legal purposes. Again, often we're using derived data to provide a more continuous picture and so that is one of the things that people often ask is can we use this data for generating navigational maps and we say please refer to office of coastal survey to get the correct navigational maps.

So we'll go ahead and start with Lake Superior here to kind of walk through what the capabilities of the tool are and all the different functions that are built into it. So one of the first things I want to show is that like several other web mapping applications, it has that very nice easy to use interface that allows you to pan and zoom in using scroll wheels if your mouse is capable of that. You can also use the "+" or "-" to zoom in and out. We'll go ahead and zoom in to Marquette, Michigan for the demonstration here just to show some of the different capabilities built into the lake level viewer.

So the first thing I want to show is that as Doug was mentioning, you'll see the [unclear 24:09] areas. These are areas where we do not have data and you can actually see the [unclear 24:14] by turning on the topography over here underneath of the console on the right hand side. We can also turn that back off. If you prefer to have just a basic map instead of imagery, you can also add that in as well depending on the audience you might be talking with and what you want to show in the visualization piece, so we'll turn the satellite back on. Another option is to actually turn on the [unclear 24:41] and so we can actually put a pin in the location. In this case we're looking at the harbor and as we start to adjust the water level over here, you'll notice in the depth queue pin is actually showing what that change in depth is in that given location and we can move that anywhere along in the coastal area and

again that updates accordingly as we go up and down in water level.

So moving over to the left hand side, this is where the bread and butter really is in visualization in that we can actually adjust these water levels and let me turn the topography back on just to show some of this. As we start to increase in water level, you can see it starts inching towards the coastline and this is what allows us to visualize a 4', 5' or 6' change in water level. We can always reset it back to the long term average by clicking on long term average and similarly we can also drop the water level and this is where having that nice new bathymetric data in the coastal area allows us to visualize the retreat of water levels and what new land areas might be exposed. So there we drop by 4', by 5' and by 6' and again if we look at this navigational, excuse me, this harbor and we put our pin here, this is where it can be very informative for those small harbors and marinas in determining what type of drop would have an impact on what type of vessels or if they need to do any type of dredging in these areas.

One of the other features that Doug mentioned was the ability to actually visually simulate the various water levels and so again either using the arrows on the left hand side or the arrows on the right hand side you can increase the water level in the lake level viewer and you'll see that using canvas, we can actually simulate what that might look like at this given location. So in the Marquette lighthouse here, you can see an increase by 3', 4', 5' and 6' would look like at that given location and there are several sites throughout the Great Lakes where we are putting these photo simulations to help people get that visualization across and we continue to add more as time allows us to do when enhancing the tool.

So let me go back to the long term average. So while I've shown a lot with the lake level change information here and again each of these layers has additional information available through the "?" to explain the data in which you're actually seeing. Some of the other data sets that we actually include, include a mapping confidence. So let me turn the topography off for this one and this allows us to better define that any area where you're seeing blue has an 80% or greater certainty that it will be wet and so again if we zoom in, there are some of these orange areas so those are areas where there is some uncertainty as to whether or not that may or may not be inundated at the time and that also is adjusted as we continue to increase water level and decrease water level as well and so again just a little bit of uncertainty because we're not completely showing, again there is a lot of [unclear 28:08] that is done in creating the DEMs and as well information with regards to the water level.

Something that we've actually borrowed from the sea level rise viewer is what we call the social vulnerability index and let me zoom out to show this [unclear 28:24]. What this is actually showing is population areas or parts of the given location and how it's related to a change in water level and how that can potentially impact the population there based on age, poverty and other population characteristics. Anywhere you are seeing a higher color such as the red or a lighter color of white or pink are higher areas for being socially vulnerable. This data is very useful for people that need to make decisions, support, thoughts or processes in regard to how an impact in increase and decrease in water level could have on the living population there. Similar to another data layer we brought in is the Bureau of Labor Statistics to show employment and again the reason being is you have an increase in coastal flooding. You may have folks that are unable to make it to work and how that could have a socio-economic impact as well.

One of the other things that a lot of people ask are I'm interested in getting the data and so the [unclear 29:42] actually provides you information on where data is available for download and so anything that is green is available and when you can actually start downloading this data directly as a zip file for the depth information and confidence information. Often people are interested in the raw DEM and so if you click on this DEM link, it will actually take you to where the data is now housed at NGDC within

NOAA and so you can actually download this data and utilize it for other projects of interest such as coastal erosion and near shore hydrology.

I'll also show a couple of other really neat features as well. The share opportunity. Say for example you're interested in sharing this [unclear 30:31] location. It will actually generate a URL that you can then email to other folks so that they can see the exact same thing that you're seeing or if you're so inclined, you can share it over social media such as Facebook, Twitter and Google+. One of the things where I want to show that this can be very useful, oops. Let me go back to selecting a different lake. So we select Lake Michigan. What I want to highlight here is a very interesting case study where having this type of information can be useful. Let's go to lake level, change information and I want to zoom in by St. Joseph's here. You'll notice that you can see the tree line here. You can see several houses are located here and more recently a house was actually built out here pretty close to the coast line. So if we go to the long term average, you can see where the current water line is and where the house is. What you'll also notice briefly in the background here as well is the high water marks and the low water marks so we can actually do the simulation to show what it might look like during a high water mark. So as we zoom in, you can see how that water line has approached very close to that house and so this high water for Lake Michigan occurred back in April, 1986. We had shown this to a few partners in the region and they were very interested of course in looking at the data because this could help with different policy and planning initiatives when looking at say coastal setbacks or again houses that might be too close to a bluff that could be potentially eroding in the future.

Let me switch back here. Alright, so there are several different ways that we did distribute the data. We distributed it as [unclear 32:41] databases via HGAP. We also do a lot of web mapping services using [unclear 32:48] map service, as well as wmaps or webmaps for people to just get the data so you can bring this into say an [unclear 32:57] online project and any of the data layers you just saw in the previous tool demonstration, you can actually bring across into a web mapping application as well, both desktop and online. There are a lot of layers to use. The lake level change layers are very helpful for folks. The uncertainty layers are also a layer that a lot of folks are interested in. We're actually also looking to potentially improve upon the uncertainty layer at this time. The socio-economic layers are very useful for people that want to study the socio-economic impacts to water level changes in the Great Lakes and of course more importantly where we have a lot of people interested are these seamless condition DEMs that provide one of the first nice representations of the coastal environment, but we are always looking to improve upon this.

We have a four prong approach when it comes to the lake level viewer. We want to visualize water level changes at screening level for educational and outreach purposes to start the discussion. We also want to use the web map services and other tools with other data. So again you can bring your data together with this data to study a potential project of interest. We also want to get the data layers to use for hazards and vulnerability assessments, identifying those critical coastal areas where we can see further bluff erosion or sediment transport in the near shore environment. Then of course use the underlying DEM for other purposes as [unclear 34:34] mentioned. Storm water, coastal hydrology, bluff erosion and sediment transport.

So what does the future work involve? Well, we've already gone back through and done [unclear 34:50] inventory and we are now starting to identify other potential data resources. As Doug has already mentioned, for the first go around we used just the airborne topo/bathy Lidar, but we understand that we're going to have to use other platforms, like multi-beams and sonar and other acoustic shipborne platforms to collect data in highly turbid environments as well as in deeper water. We are going to update with new topo/bathy data and start filling in some of these gaps such as the image showing in

St. Louis River Harbor, excuse me. Duluth Superior Harbor Twin Ports area and again we are looking for feedback from users of the tool and the data and we use that feedback to help improve the next version and so we are still always actively listening to folks input in what to do for the further enhancements and then again based on those enhancements, excuse me, the feedback we'll develop the enhancement for management applications down the road and incorporate other data potentially into the tool to improve the visualization experience.

Here is just a snapshot right now of some of the work that's going on. So these are some of the updates that are under way. One of the bigger data gaps that Doug had shown previously was Lake Huron northern section here between [unclear 36:14] city and Saginaw Bay so we are going to start incorporating that data to the viewer. We are also incorporating a lot of data for the Green Bay part of Wisconsin in Lake Michigan to the viewer and the data as well.

So here's just a list of resources. I know that this is being recorded and will be shared out and so we wanted to make sure that everybody is aware of where to go for the lake level viewer, the digital coast, the US Interagency Elevation Inventory as Doug had previously mentioned. That's where a lot of the raw data that's used in the tool can be found. We also have a link to Coastal Lidar Data so people can become more familiar with that technology. CanVis is a free and open software solution that people can use to create some more of these photo simulations that are very helpful when talking about these changes with the public and the decision makers and then of course we want to point back to the GLERL water level dashboard, which we link to to show those average high and low water levels.

Jill: Okay, thanks Brandon. Let me, Doug you are there, right?

Doug: Yes.

Jill: Okay. We have gotten quite a few questions and so let me just start asking. I think these were Brandon when you were starting to show the viewers, so let me ask these and then Doug if you want to chime in you can as well. First question is how were the society and business layers identified as important features and then also stakeholder interaction was a question she had. Was it because of stakeholder interaction?

Doug: I think I can answer that. This is Doug. So part of it is that the societal vulnerability index and social vulnerability index that Brandon showed, that's a data step that we also had included into our national, we have another tool. It's called a Sea Level Rise in Coastal Impact Viewer, which maps sea level rise impact, coastal sea level rise impacts around the country on the ocean side and that tool brings in the social vulnerability index information so part of it was to be consistent with what we were doing there. That layer is coming from methodology developed by the University of South Carolina and is currently at the census tract level. The business information, we're actually in the process of working with the Bureau of [unclear 39:10] Statistics to get refinement of that at the tract level as well. That is something that we're starting to develop a relationship with the Bureau of Labor Statistics and people want to look at what the potential impacts were of the number of employees that could potentially be impacted. Part of our constraint on these data sets is they have to be national and available, obviously available everywhere and we don't have the ability to bring in local data that, for instance specific county data information. It becomes too much of a resource to include all the local data sets, so we did do a lot of stakeholder engagement. Initially we had what was going to be an actual workshop. It ended up being a virtual workshop that we did get a lot of input into the requirement process. We also conducted some interviews. We were working with Wisconsin Sea Grant, David Hart and his colleague Rob Roth at the University there helped us conduct some interviews and did some

use cases with different types of users to give us input into the development of it. So the idea of using the map services and bringing this information or downloading the data to bring it into your local GIS or your local layers is what we encourage. We don't have the ability to do that everywhere, to bring it on the local data set into a national viewer like this so we kind of had to pick and choose what we show in there and the idea here is just to relay and start to show the impact on society and economics as sort of a cursory screening level and not to do a robust analysis.

Jill: Thanks Doug. Another question that we had was for the data download. Is it just a file of all the data or do you have the ability to generate specific subsets if the user desires?

Brandon: Doug, I'll go ahead and take that one on. As far as the data downloads, the zip file will actually contain when you download say the depth information, it is all 13 layers so the +6', the -6' and of course the long term average for that information, if you're interested in just a particular layer to look at, I actually suggest using the rest API service because then you can just select one layer to view or look at, but we do package it all together. The DEMs are actually broke up into tiles across the Great Lakes. So for example, I'm just trying to remember off the top of my head, Lake Superior is 7 different tiles and similarly Michigan is broken up into tiles that actually coordinate with the weather forecast offices within NOAA and then of course the other lakes are much easier because they're a smaller file size in that regard.

Jill: Okay, thanks Brandon. One question that someone had was clarification is that "data or model information that's being used".

Brandon: This is Brandon and I can touch on this. Doug definitely can follow up. When we talk about modeling, the modeling part of it is actually the way the depth grids are created so we actually used a bathtub model, basically everything across the board raises at the same water level and again that's why you have to be very specific about which lake you use in the viewer and then could you repeat the second part of that Jill?

Jill: Is it data or model information that is being used?

Brandon: And so yeah, the data side of things is elevation information so the Lidar data is collected and then that's [unclear 43:39] to create a DEM, digital elevation model. So again there's the other side of modeling, but it is data. As far as modeling, there is no actual physical modeling that is occurring other than just doing that bathtub approach to the water levels. Doug is there anything you want to add onto that?

Doug: That's a pretty good description. Also the water level data that the DEMs is another data piece and the showing the long term average, the current water levels, the highs and the lows in there, that's coming directly from the water levels dashboard and we actually have a data service that pulls that information in so every month there's a group, it's actually an international group that looks at the water levels on the Canadian side there involved as well. We don't do the mapping on the Canadian side, but they do it and they work on what the monthly water levels are and that information gets pulled in as a service and it gets displayed here so the water level information to the nearest [unclear 44:47], but maybe the confusion is with a digital elevation model, it is a model of the ground or the elevation surface or the [unclear 44:56] as well so there is an art to filling in gaps where there is some data and that's part of what we call a conditioning process, but getting the base layer elevation data as good as we can get it before we start doing the mapping is a crucial component, but like Brandon says, this is raising and lowering the water on a sunny day essentially. It's not looking at wind driven surge,

[unclear 45:21] or anything like that or any type of sedimentation processes. It's strictly to look at what would happen in a changing shoreline situation.

Jill: Okay thanks Doug. We had a question dealing with did assessment of flooding consider any shoreline protection structures? If it did, how would you estimate lifespan of shoreline structures?

Doug: You want me to take that one Brandon?

Brandon: Yeah, if you want to start Doug.

Doug: So again I think I kind of answered it in the last response. We're not taking into account that original processes or wave run off processes that occur during storms. There are other studies going on to look at that. For instance, the Federal Emergency Management Agency, FEMA, is involved in updating the flood insurance studies for the Great Lakes. Those studies do rely on hydrodynamic modeling and waves impacts on the coast for individual storm events and so things like shoreline hardening and sea walls and things like that would be taken into account. In this situation in our viewer where we're doing as Brandon said, that type of approach so we are looking at if it is sort of connected to the ocean now when we expand the water levels inland, we basically try to connect that to see if it's going to be impacted, but it does not take into account what the human response would be in terms of existing or new sea walls or [unclear 47:11].

Brandon: I was just going to add to that Doug and again often the question that gets asked is the hydrological connectivity to say for example wetlands or water behind say a barrier island. We do not take into account [unclear 47:33] coverts or other hydrolic features in consideration of this approach. Again it's a very simple step in doing some of the visualization. For those folks that are interested in that, that's why we do make the data available so they can take it the next step further to put it into those hydrodynamic models that Doug was talking about or hydrolic and hydrology models that people often work with as well.

Jill: Another question is there any coordination with FEMA, Great Lakes flood plain management updates in terms of data collection, Lidar particularly for [unclear 48:17]?

Doug: Brandon?

Brandon: Yeah, I'll go ahead and take that one Doug. So we do work with FEMA in identifying where they are collecting data in the past. That's actually part of the work that we're doing right now as far as identifying potential collectionary here in the future because we obviously don't want to be redundant on data collects. We're trying to maximize dollars as far as the efficiency in collecting data and so we do coordinate with our partners in FEMA. Also as well with the Association of State Flood Plain Managers who is also involved with some of the work with FEMA in the updates here in the Great Lakes. The other thing I want people to be aware of is as we start to hear more about where they are collecting data in the Great Lakes, we actually add that in to the US Interagency Elevation Inventory and so for example, I know that if you zoom in on parts of Northern Michigan, you'll actually see a few areas that show the future collects that FEMA will be doing for the Great Lakes, such as [unclear 49:32] County in Michigan. So we are, again we want to be aware of the efforts that FEMA is doing and of course all the partners they're working with because again the data they collect for that can be utilized in improving the lake level viewer and then similarly too, we coordinate with the Army Corps of Engineers and FEMA to see where we can start to help filling in those gaps as well. As Doug was previously mentioning in the presentation, that's been a big part of the work we've been doing over the

last couple of months right now is being aware of those different efforts. So again, the Army Corps, FEMA, the USGS with their 3D elevation program and the updates that they're doing in collecting data also here in the Great Lakes region.

Doug: I would just mention the elevation inventory that I mentioned earlier is partnership with the agencies like the USGS. FEMA has been part of that as well so that we're basically trying to have an inventory of where this is being best available [unclear 50:43] so that all the studies that are going on will be used in a consistent data.

Jill: Thanks Doug and Brandon. Another question that we had was dealing with whether or not this tool could ever possibly be used for like inland lakes.

Brandon: Doug, do you want to start or do you want me to take that one?

Doug: Well so a lot of it is depending on, you can map. I can take a stab at it Brandon. You can map any shoreline if you have the adequate data. In other words, you have data that is required. In this case we had to have elevation data. We had to have the symmetry information so if an inland lake for instance had surrounding elevation data and you knew that the symmetry, you could do a very similar process to develop the surface and then you could map different water levels along that surface. So as long as you produce a surface that has that information in there, you can view various water levels [unclear 51:55] just as easily. We had to do this in our [unclear 52:00] mapping. In some cases these inland lakes would be shown because they're not connected. We end up kind of keeping them out and we either show them as areas of different areas that potentially could be impacted by closed basin flooding. Closed basin flooding is kind of like small little watersheds that drain in on themselves and don't necessarily drain out to the ocean and so there are issues with a lot of that. There's a lot of that kind of [unclear 52:26] type topography in Florida that's particularly difficult, but certainly you can do this same process for any lake or any water body if you have the right information.

Brandon: This is Brandon and just to add to Doug. Doug touched a lot on the data side of things. In regard to the tool, the actual viewer itself, the code is available if people are interested in developing an application similar to the lake level viewer. As Doug had previously mentioned, the lake level viewer, a lot of the code that goes behind it and the creation of that was just basically the same as the two level rise viewer just adapted to the Great Lakes region, but that is using things like open layers three for those folks that do any type of web mapping and more the open source kind of things in creating that visualization tool so like Doug said, as long as you have the data, you can then easily bring it into a visualization tool like the lake level viewer.

Jill: Alright, thank you. Another question that we had was and I don't know these acronyms so I'm just going to say these. Is there any intention of showing lake levels in NAV88 instead of IGLD85?

Doug: No. This is Doug. The data that is used in the Great Lakes is the International Great Lakes Data of 85 and when we did the initial stakeholder engagement that's one of the things we asked and that's something that was a requirement built in that we also share not only on the right side of the viewer [unclear 54:22] is the relative difference between long term average and adding 1, 2, 3, 4, 5 and 6 feet and subtracting that, that we also have the actual elevation values. So the feedback that we got from IGLD is the data that we should be providing [unclear 54:42]. There are conversions between IGLD and NAV88 that are out there that's necessary for applications and there's resources to be able to do that, but the data that you download would be and the elevation data would be and I'm pretty sure about this, would be IGLD so that's something that was a requirement from the initial engagement process.

Anything to add to that Brandon?

Brandon: No, I think you did a great job on explaining that Doug. People are interested, yes they can definitely go in and grab the data and do the conversion to NAV88 as they need for their project.

Jill: Alright, thanks. Another question that we had and I don't believe that you had answered this already. Dealing with layers, someone was asking about adding an ecological layer such as wetlands, emergent vegetation or environmental sensitivity index.

Brandon: So this is Brandon. I can touch on that a little bit. Yes, based on user feedback from folks in the field, as you can see we did put in a couple of layers of the socio-economic data. One of the layers that we could also potentially bring across and I've actually in the past demonstrated this through RTS online is bringing in our coastal change analysis program land cover data again to show increases and decreases in water level and how that relates to the various different land cover types and so within the coastal change analysis program land cover data, we actually do break up the wetlands into quite a few different groups so that folks can see the impacts on emergent wetland vegetation or [unclear 56:39] shrub or forest wetlands as well and so that's one of the things that we're potentially looking at for the next enhancement in the lake level viewer and it's actually in discussion right now. Doug, is there anything to add?

Doug: No that's good. That covers it.

Jill: This is another one dealing with some of the feedback specifically how did the virtual workshop interviews influence the design? What if anything changed significantly from earlier versions?

Doug: I can answer that. This is Doug. In the development process, we go through a process where we spend a lot of time up front on a requirement analysis and pulling together the requirement, we were in the stakeholder engagement we did a couple of virtual workshops and received information. Part of that is to show an existing tool that we knew hand and knew it was going to be based on so we had existing viewer for visualizing sea level rise, we showed that and said we want to do something similar to this, but we were also collecting feedback about what other functions and features it needed to have. We went through a process of developing what's called a wire frame, a low fidelity and high fidelity wire frame and that's basically a low fidelity is almost like a drawing of what the tool might look like. These were, we worked again with the University of Wisconsin Sea Grant to share some of these wire frames for folks to see what it's going to look like and then provided input just as an example to be able to show the topography as Brandon demonstrated to be able to turn on and off the topographic layer there and make it with a varying [unclear 58:423] so you can see through it and you can, which is pretty neat. If you didn't get to see it in the download or if you go to look at some of the [unclear 58:50] areas you can turn on and slide that [unclear 58:54] and see through the satellite images where you can actually see some of the underlying sediment features and then you can turn on and off the symmetry layer and see that. That was a direct feedback from our engagement process. So we were able to show those wire framing products, get input on those and then before we went into the design and the actual coding development process, we would pass through all of the changes that needed to happen up front so that they could go and code it really quickly and get it out so that was definitely part of the process.

Jill: Thanks Doug. One last question. We are at the top of the hour and I had one final question for both of you. A couple people asked whether or not there is an example of a city that has already used this tool and how did they use the tool?

Brandon: So this is Brandon. I'll go ahead and start and Doug can finish up here. So we haven't got any examples right now that we can think of, but we're always aware of you know wanting to be knowing what's going on out in the region so if folks are using this tool, what their city governments or county government, definitely let us know. The tool was released publicly last year and so over the last six or eight months or so as people are starting to use this, we definitely want to hear back and actually one of the things we do is highlight that work through things like [unclear 1:00:45] from the field that actually get linked back to the tool page so that people can understand how the tool is being utilized or how the data was being utilized in one of those decisions support rules. So we're not aware of anybody yet. Doug and I have definitely been out in the field and providing people demonstrations and presentations [unclear 1:01:10] and we hope that people start to take a greater approach and if it isn't meeting your needs, please provide that feedback as well because we definitely use that information in providing future enhancements.

Doug: This is Doug. I'll just add to that. People are downloading the data and they are accessing the viewer based on our web stats and we can track the number of downloads. We don't have a great way of figuring out how they're using it. We can't really track personal information. We do know with previous experience with working on the ocean coasts, there are a lot of agencies interested in changing water level information. Specifically we've worked with the EPA for their points for solution outfalls looking at impacts on that. We've had the Department of Energy looking at some of their energy facilities. We had DOD interested in looking at some of that, especially the Navy and installation of impact to sea level rise. So we're pretty sure there's folks that are going to be looking at this. It's interesting to track some of the web stats. It's only been out as Brandon mentioned since October, but we've definitely seen a spike back then obviously because it was new and did a lot of outreach. There's been I think a lull because the lakes were covered with a lot of ice over this winter. Maybe people weren't as concerned about lake levels because [unclear 1:02:42] and so we'll be interested to see how it progresses into the spring time. Also lake levels are going up again and the low lake level issue isn't as maybe in the forefront of people's minds, they tend to forget the issue when things change so based on our previous experience, these are areas that we've had partners, for instance the state of New Jersey wanted to take the viewer and incorporate their own local data into it. That's why Brandon mentioned the code is definitely available to start doing that. So it's definitely something that we're going to keep tracking and let us know folks that are on today if there's an interest and definitely get in touch with us.

Jill: Thanks Doug. We do have a question in the survey that we'll be sending out to everyone about feedback so please if you have a few minutes to start that survey and fill that out. NOAA would really like to get your feedback about the tool. Well we are past 1 o'clock so I wanted to thank Doug and Brandon for their willingness to talk with us today about the [unclear 1:04:00] tool, the lake level viewer. It was really an excellent discussion and also a special thank you to NOAA and to Minnesota Sea Grant for funding this webinar through coastal storms program project. I again want to remind everyone about the survey URL, that it is in the chat feature. If you could take a few minutes to fill that out and also I wanted to refer to you resources and an archive of all previous webinar and presentations, which are located on our ChangingClimate.osu.edu website as well as our regional site at GreatLakesClimate.com. This webinar series is sponsored by OSU Climate Change Outreach team and will host the next webinar June 16 with NOAA Coastal Services Center who will be talking about green infrastructure case studies in Minnesota and Ohio. The registration is up in the chat so feel free to register now. Thank you again Doug and Brandon and all the participants on this webinar. We hope this was beneficial and hope you will join us again in an upcoming webinar. Thanks again Doug and Brandon and have a great afternoon.

Brandon: Thank you.