

StreamBox

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>>> Good morning, everybody. We'll be starting in about five minutes. Good morning. I think I need to wait for Amber's official signal before starting. As you know, it's a public meeting. Are we okay? Okay, great.

Good morning, everyone, welcome to day two of the HSRP meeting. I'm Julie Thomas, chair of the panel. I'm retired now for a couple years. Still an adviser and I live in San Diego. Today we have a few really exciting panels. I think first we're going to go around and let everybody do their introductions. We will start with -- if you could just give your name and where you live. Where you're from. Mary, do you want to go first?

>> Caller 2: I will, yes. Mary Paige Abbott. I reside on Sanibel Island in Florida.

>> Qassim Abdullah.

>> Anuj had to step outside. Captain Alex Cruz is with us this morning. Thank you for joining.

>> My pleasure. Alex Cruz, in the island of Puerto Rico.

>>: Good morning. Sean Duffy, big River Coalition, along the mighty Mississippi. A little salty today.

>> Good morning. Nicole Elko, executive director of the American shore and beach preservation and I'm based outside of Charleston, South Carolina.

>> Lindsay Gee. I live in New Hampshire and Hawaii.

>> I'm the geoscience manager living and working out of Nancy Pelosi Nancy Pelosi.

>> Ann McIntyre and I live in San Francisco.

>> Tuba lives in Oregon.

>> Eric Peace. Live in Cleveland, Ohio.

>> Ed Saade, San Diego, California.

>> Good morning. Nathan Wardwell working and living in Anchorage, Alaska.

>> Hi. I'm Derrick Snowden and I live here in Silver Spring, Maryland.

>> Good morning. Rachel Dempsey.

>> Julianna Blackwell. I live in north Virginia.

>> Andy Armstrong, co-director at the NOAA New Hampshire.

>> It's my pleasure to co-chair with Admiral Evans and I'll turn it over to you for a few comments.

>> My name is Ben Evans. I serve as a designated federal official for this panel. Pleasure to be here. I do have just a couple housekeeping notes with respect to public comments. Thank you to the participants who have provided public comments in advance. We encourage your public comments and input. If you have

a comment type it into the webinar under the questions tab. It will be read into the public record or put on the screen if time permits. All the comments will be included in the official meeting minutes. When comments are received in advance, they will also be shared and highlighted at the meeting as well as become part of the public record. We welcome and encourage comments from any group directly or individuals during the public comment period. We also have a period for public comments at the end of the day today, at which point we'll receive public comments from the floor.

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Emergency exits are fairly obvious around the room, also out through the doors to which you entered and then either right or left and the heads are directly across the passage way outside the meeting room. That's all I have, Julie. Happy to pass it back.
>> Thank you very much. I'm really excited to introduce the next panel on the NOAA and SOS opportunities in modelling efforts in co-ops. I talked to the director to put together this panel because I know they're doing such good work internally within NOS and I'm not sure that the panel is even aware of some of these models that are being worked on. So I thought it would be a really good education. We hear a lot from the director's reports but this is a little deeper dive into what is going on behind the scenes with some of these modelling efforts. I also think it's important to understand these models and know what NOAA is doing here because we all work out in the community. We're talking with other stakeholders. I want to be able to share some of this good work that's going on so I really appreciate it. Shachak Peeri is moderating and I will turn it over to you.

>> Thank you so much. Good morning, everybody, and welcome to the modelling session in support of marine navigation. It's really exciting to be here. Before we begin and have a presentation, I wanted to emphasize that we in the foundation which is co-opposite, NGS, OCS are one big happy family and work on many activities. Today you'll hear a lot about modelling. I won't go into the work flows that different groups are doing but emphasize that we work with academia, academic engagements. We work closely on how to vet and develop models, and then implement that into our infrastructure and make that operational and keep that in maintenance and update them as we move forward.

Today you'll hear different pieces of this work flow. First we'll talk with Mr. Pat Burke. After that we'll hear about resurgent tidal forecast system. After that we'll talk about the success story with our partners about the unified forecast systems and last but not least, work that NGS is doing with modelling. With that, I'll pass the mic to Mr. Pat Burke to present the first presentation. Thank you.

>> Good morning. How is everybody doing? All right, we're lively today. My name is

Pat Burke. I'm the division chief at co-ops. I'm super excited to talk to you guys about what we're doing. I'll start my slides. Here we go. A little bit of motivation first on what we do. Sean just talked about salt in the Mississippi. There's other things going on. Clearly we have a marine navigation mission here within our offices and we're looking at how to support that. It's a \$4.6 trillion industry, so there's a lot of money coming in boosting the economy, jobs as well as. More importantly, in where we are right now it's the data that also matters. So modelling, think of that as a large data set that can help supplement observations. The info graphic on the left shows the importance in load planning and what an inch of free board gives you in what we're trying to do. The salinity, the water temperature is going to affect if your ship is going to hit the bottom.

The other thing, moving from navigation, is more a resilience mission we're looking at. If you remember, folks in Texas back in 2017 with Hurricane Harvey, a massive amount of rainfall. The thing that was overlooked during that was the graphic on the upper right there is 40 chemical sites where, because of the flooding that was going on, a lot of the chemicals were seeping into the water supply and they were asking us where is the water going, not only the salt coming in contaminating the water from the ocean but also coming out from the river.

That's where the motivation around this is. That's the power of modelling. It's more than just measurements. If we're lucky to have them, great, but the models show us what we're doing

I'll take a high level view first and talk about what we're doing in the office. We have a strategy in the office service. It was published earlier this year. Our vision is to get this information to the users and we want to make sure it's accurate and reliable.

We have three goals. First and foremost we want to work with the user community and make sure what we're delivering is going to be used by the users.

Number two, this is a community effort. We also work with the academic community and other agencies as well and that's an important focus. Three is more of an aspirational goal moving into more of a forecasting role. What we do right now is provide guidance and people interpret what we are but moving and working with the folks at the weather service and other places to help forecast what we're doing.

I want to put this as a mental image for everybody to think about what we're trying to do. At least in co-ops, we're an operational shop and there are key components.

You've heard about our observation networks a little yesterday in Derrick's talks. We also have management monitoring of those systems and want to make sure they're reliable and it's getting out to the users. More importantly is that continued conversation with end users in the community. It's not just a one-time only thing.

I'm going to walk through some of these components today as I go through my talk to give you guys a clear picture of what we're doing.

As I said, NOAA and NOS has a broad mission. Our focus is on navigation but there are other parts of the ocean service that are relying on this too. As we start this engagement, we're looking at what we have, it's called a NOAA service delivery framework, another published document we use. We call it the wheel. Again, we

continue to talk to everybody about it and trying to make sure as we're building these models that there are other requirements that we need as well as the navigation missions we're trying to do, we want to know about it. So when we build these models we're trying to address as many of these as possible. I talked about navigation resilience but the minimum is we're trying to hit the navigational requirements first and foremost.

We call these our ocean operational forecast. They're driven by realtime data, but really it's a continuous process and a nexus point for what we do. We have the observations coming in. Models are run. There's a bunch of standards taking a look at this. There's a constant cadence behind this and we're making sure that things are going out. We forecast two to five days on water levels, salinity and currents. The graphic on the right shows our current operational forecast systems and where we are. We're still trying to get coverage and I'll talk to that in a second. We run weather service platforms, their super computer system. It's very secure and they keep that at high level operations as well, 99.9% metric. On our staff we have what we call tier three support. Anything breaks, we're picking up the phone and finding out what's going on to make sure we have that fix.

I mentioned navigation requirements. Any model we build we have to satisfy these at a minimum before we think about the other needs as well. It's open source. We work with the community. All our model are not developed in NOAA. We work with the community and they help deliver the code. We want to make sure when we build our domains that they go to the head of tide. Making sure we're going either when the tide is over or a dam like the Hudson or the Columbia River. We want to resolve those channels as well. These are high resolution models on the order of tens of meters. I talked about the forecast period, a minimum of 48 hours and these outputs are going to other things. Precision navigation for currents. We make sure water levels are used by the navigation community. We have documented metrics of skill. How well are these models performing and we work those to navigation requirements.

For example, when we put things out for water level we're making sure we're within 15 centimeters. You can count on the accuracy. All that data is internal. We can use outside data as well for validation but the force is requirement is we need to have things inside to run.

I talked about the strategy we have. We're also working on an implementation plan for that strategy and here are some quick highlights about what to expect in the near future. We're working on a combined sailish sea model with Columbia River. That's probably coming online in the fall of '24. Then we have three other projects going on. We work with partners in the Great Lakes. We're looking to expand our model coverage in the lakes to work with the river systems there. This is a graphic showing who we're working with. We're trying to connect our coastal or Great Lakes domains with those models to get the answers like where is the salt going in the river systems.

We're also working on a large model for the northeast coast and that's that graphic

there on the lower right. And then another one, if you remember the graphic I showed about the domain in the southeast, we're working as well with the community partner, what we call the southeast coast OFS. The last three models are being supported with bipartisan infrastructure law funding so given that opportunity we're trying to accelerate our planning and we're working towards those goals. You can expect over the course of the next few years we're going to get to that vision of complete coastal coverage.

I talked about our broader application needs. We also have some regional applications where we're supporting regional navigation requirements but also expanding these to look at things like ecosystems and human health and search and rescue. We have two larger domains, one on the west coast and another one in development for the east coast that will be coming online in '28. These are a little different. We're assimilating data. This is the cutting or leading edge of what we're doing here in NOS where we're taking data from satellites, and then we have these larger applications. These are a little lower resolution, four kilometer, but we're using these models again not only to help with these regional applications but as boundary conditions into our models we're looking to support.

I've talked about the stakeholder needs, about the support we have behind the scenes in terms of maintaining but we're going to talk about delivery, how you're going to get access to this stuff. Derrick highlighted in his talk yesterday the release of -- [indiscernible]. Here's an example where we're taking our modelling systems and putting them in more of a user accessible environment where it's actually point and click. You can customize these views. We're looking at Cook Inlet. That graphic shows how we're doing with observations. You have there a very in depth look at how we're doing and how it's matching predictions as well as observations. We're trying to grow confidence in using these applications.

More importantly also with this is that you're not relegated to just the points we have observations. You can click anywhere on that map and get a read. We're building this product again with folks in the northeast right now through some pilot projects. We'll have initial beta release soon, we're hoping early January.

Lastly, marine channels forecast. Here we have two in operations, one in Mobile Bay, another in Tampa, when we're taking observations not only from the oceanographic community but the weather community. You can get water level current but I think the key here, you also get a waves forecast built in from the weather service as well as visibility forecast from their weather forecast office. You can click a point along that channel but more importantly you can have a long channel look so as you're moving down you can see what you're doing.

Lastly, this is a rather complicated slide but look at the green boxes here. We talked about skill assessment and how to build competence in using these models again through BIL funding, we're trying to build a skill assessment module. We have standards but we want to make those not only useful within NOS and NOAA but also with the community. They're looking at the same metrics as us so we have a better understanding through the development process how the model is being

developed and how it's performing and we can provide on the spot recommendations. We're happy about this and hopefully get this out in the next couple years.

We want to talk about the challenges we're having. If you talk to modelers, they always want more data. But we have to be very careful in what we take in. We want to share that that data is using standard QC. We want to know that the data is always going to be there so we can use it. We're also looking at new technologies, those opportunities to work with folks both inside and outside NOAA about some of these things, things like gliders and other satellite technologies.

We do have a little bit of funding for research but not a lot. We work with our community partners in the regional associations that I use. They have what we call a coastal modelling test bed where they do some work for us where we have requirements that we're working with them from a navigation angle and see the possibility to transition. I talked about data assimilation. We're also working with the water center at the weather service about coupling challenges in terms of exchanging information between the river systems and the estuaries.

Finally, my last slide, it talked about the close collaboration. That's essential in continuing to work with the community not only on the data and modelling but some of these other tools we're trying to build. I talked about the coupling solutions. Always need more HPC allocations on the computer so we can run experiments. We have some slots there but always time for more of that. Then lastly, we're looking at things like machine learning. Modelling is a bunch of equations we run over a short period of time and from a wall clock standard people want these things quicker and faster so we're looking at things like machine learning to see if we can speed up some of that and also look at the accuracy. That's an emerging thing. There's a lot of that conversation here. I think that's it. Thank you. Hopefully you learned something. I'm going to pass it to Greg.

>> thank you, Pat. the next conversation is going to be a tag presentation. I'm currently leading Nat ocean service team located within the office of coast survey in the modelling part of the office. we are leading all the way from research and development, research and operation and operational support of these modelling systems.

>> Good morning. My name is Greg. I'm a physical scientist in coast survey development lab. I support a couple of projects including the surge and tide operational system as well as S100 which you might have heard for supporting marine navigation. Thank you.

>> Thank you, Greg. Today we are going to talk about office of coast survey surge and tide operational forecast system. We're going to provide you an update. I just want to acknowledge our academic partners here. We are working very closely with the University of Notre Dame to the global component and we are working with [indiscernible] on the treaty component. Of course, nothing can come through without partnership and close collaboration with various different people. First of all, I want to acknowledge other team members. We are working with research and

development, working with academia partners as well as operational support. That's why we have this variety of different partnerships building throughout the years and also we have a number of people that also are working on research and developmental side of this. You can see a list of our academic partners, agency partners, international and industrial and cooperate partners.

09:27:26 In terms of end users and stakeholders, we are primarily concentrated on coastal resilience and disaster mitigation and tide operations and of course also being from office of coast survey we are always also want to make sure we are trying to and strive to satisfy navigation support for safe and precise navigation. From disaster mitigation and coastal resilience point of view, we are working with different users and stakeholders but mainly through working with National Weather Service and NOAA weather forecast offices, WFOs are using multiple outputs to generate flood forecast and warnings specifically during storms. We also work with different centers at National Weather Services, providing different kind of support to this type of centers. For instance, for the national weather service we are supporting them in terms of hydrology and coastal land flooding, compound flooding. That was one of the main support we have provided, as well as our models also provide boundary condition and water surface elevation to help them push their inland models with the effect of coastal and tides.

Also we are working with environmental modelling center supporting them with their near shore weather system. This is an important component at the National Weather Service for disaster mitigation, so this is also depending on our modelling. Before turning it to Greg to continue, I just want to briefly go over some of the product and services that the national ocean services modelling team are providing. I will just go over a little bit on the research and development part.

So, one of the exciting -- sorry, talking in front of sup an esteemed audience is not easy. Anyway, we are working with the National Hurricane Center and supporting them to develop next generation storm surge models. We also work with different open source tools like OCS mesh which is basically on demand and data driven system. It's really sitting between the national [indiscernible] source and our modelling plus precise navigation. The way it works, basically we want to have our modelling components to get updated as soon as possible. We get new information into our system to be able to resolve all of the water channels to the latest information.

We also have a couple of other works that we are doing including the work that Pat mentioned in terms of coupling. Our team is also kind of leading the implementation of the unified system for coastal and that's going to be part of the portfolio. We're going to talk about how we're using the system to evaluate different applications for different use cases.

Last but not least, we also support the department of state, overseas building operations and providing them with some type of risk analysis in terms of situated close to the coast lines with the possibility of getting inundated and impacted by a storm surge. I think at this point I'm going to let Greg continue.

>> Thanks, Saed. I'm here to talk about surge and tide operational forecast system. It's mainly supporting coastal resilience applications but also the marine navigation. There's two components that I'll talk about today, the 2-D global component and the three dimensional component.

You can see in the top left Atlantic Pacific and Micronesia. We merged these into a global system so on the top right you see an image of the bath im tree underlying this system and it's critical for modelling on bath im tree. an ultra high resolution along the coastline. So up to 30 meters, mostly 120-meter resolution or grid spacing for the U.S. coast, Alaska and Hawaii. We produce a 7.5 day forecast water level so this is the tides, the surge and the combination of those. We run it four times a day. On the west coast you can see the grid spacing going very high resolution and resolving the jetties there, critical for navigation and coastal resilience. Just some bullets on the bottom right showing the upgrade in place that will occur later this year. We're very reliant on observations there.

I know Julie Thomas requested some information on accuracy and uncertainty in the modelling so wanted to briefly touch on that. We work with our partners at the University of Notre Dame to do a one-year [indiscernible] cast in 2017 comparing the operational model which will be in place later this year. You can see on the bottom left this is the average absolute error comparison. The X axis is the upgraded model and Y is operational. When we compare the upgraded model we see 18 centimeters in the operational model down to 7 centimeters. As Pat mentioned, the skill metrics, we're looking at like 15 centimeters for the navigation and then about 20 centimeters for coastal resilience. So we're well within that range.

Also wanted to mention the global model is the most accurate assimilated model today. It's a fantastic model to use. A couple slides on the Atlantic three dimensional Atlantic. When I say three dimensional, we have layered modelling. You can see the vertical layers in the model. This is adaptive. We can go into the estuaries and adapt that vertical layering. We model the density, temperature and salinity in this model. Then the effects of that on the water level. The focus is water level for these models. We will be producing a four-day forecast water level, currents, temperature and salinity from this. Again, this is very high resolution, so down to less than ten-meter resolution in small streams and levies.

You can see the domain on the top middle figure. We're expanding that to include the Saint Lawrence river. You see a mesh from the model grid on the right of the Mississippi river and you can start to see some of the levies being implemented here.

In the upgrade we have later this year we'll have major improvements to that watershed mesh. And again, expanding model coverage to improve accuracy as well. Some information on the accuracy of that, so again we work with the Virginia Institute of Marine Science. This is a schism-based model. We did a one-year hind cast for 2015 and comparing the operational model to the upgraded model so focusing on the red numbers here. Square error against co-ops. This is without any

by as correction at all. It's an impressive performance, whereas in the global model we have a bias correction at the station. You see the spatial variability in the errors in the square on the right and the bias in the bottom left. We're working to continually improve this.

And then finally, the last component just to briefly touch on, we're developing a STOFS three dimensional Pacific model. This is an area of high priority for NOAA and the nation. We want to improve the bathymetry and provide surface currents for navigation as well as water guidance to support planning for key Pacific ports. You see on the bottom left the image of the domain for the model, most of the Pacific, north Pacific. We zoom in to Guam and the harbor, very high resolution here. We're working with the weather forecast office in Guam. The global model is their only model that they use for flooding and they really rely on this. We'll hopefully provide more information here.

You can see here Fiji as well and zooming into Suva here. Lastly, I want to talk about precision marine navigation. This is the S100 suite of high hydrographic area. We work with the model output to get into these data standards, follow these to provide information to the mariner.

I wanted to talk about S104 water levels. A big challenge is that our coastal models are initially reference today sea level but for charting navigation as you know we need to use chart data. We're working to produce S104 water levels relative to chart datum to remove the model datum and convert to the mean level water datum. You see in the bottom left is [indiscernible]. From the global model we have on the ENC, you can see an example a pick report for the water level, the water level trend and the information for that area.

How do you access STOFS results. This is displaying STOFS 3-D Atlantic forecast guidance. You can sample it. On the top right we have the experiment at STOFS landing page where we run a skill assessment for every cycle. You can see that against co-ops observations and some other observations in the bottom right. And then I wanted to talk about coastal risk live. There's a link there. This is an example for Dahlia this summer. You can look at Cedar Key, Florida. The model observed comparison is very good for this storm. We're also looking at Ophelia that performed very well. If you want to look at the raw data, we have the data on the cloud.

I appreciate your attention. Saed and I appreciate it. I just wanted to end with the contact information and some images of west coast jetties from STOFS 3-D Atlantic. So really improving that. Getting into the small creeks and streams. Thank you. Appreciate it.

>> Good morning. Everyone. I am associated associated with the [indiscernible] institute from the University of Michigan. I'm from Ann Arbor, Michigan. Let me advance my slide.

Today I wanted to give an update for UFS unified forecast system coastal application team. It's been my pleasure to be part of this effort and I wanted to emphasize this is a big team effort led by Dr. Peeri who is chairing this panel. I also wanted to note

that Dr. [Indiscernible] who is sitting next to me is facilitating all kinds of communications with me. I just wanted to note that before I start this talk. Under UFS CAT coastal application team, there are three subapplication themes, safe and efficient navigation, risk reduction, and total water level. For today's presentation, I want to have a larger focus on safe and efficient navigation. The team has made great progress on this over the past year. Saed touched on unified forecast system and I wanted to give a little bit of background. The CAT team is part of a larger development within NOAA that includes federal and academic partners to consolidate them into individual modelling systems which are global and regional modelling systems using a smaller set of coupled Earth system models that will continue to serve various stakeholders.

Greg touched on S100. It's very closely tied and under UFS CAT working group, the goal is to evaluate the ocean graphic models that prelate in complex coastal environment. Here are the list of team members that list of federal scientists and also academic partners. We would like to thank NOAA and NOS water team for funding support for two years of this effort. We would also like to express our appreciation to Dr. Chen from the University of Massachusetts Dartmouth for their generous support throughout this model application effort. They are very helpful in educating and engaging with testers both from government and academia. We would also like to thank the [indiscernible] center for providing work space for model development, I.T. support for this model evaluation effort.

In phase one of UFS CAT, the team requested all three working groups or subapplication teams to generate consensus guidelines for metrics, criteria, and competing ocean graphic models for further model evaluation in subsequent phases. That also includes that model variables should be evaluated and what associated model component to be assessed. The consensus guidelines generated one was compiled into reports which were published at NOAA technical memorandum. On the left side you can see a cover sheet report from marine navigation subapplication.

We came up with a set of requirements based on the interaction with marine navigation communities to support navigation. It was determined that the mariner's need forecast guidance for water levels, surface current, temperature, water temperature and salinity. International hydrographic organization is also collecting requirements to create product -- yeah, so Greg touched on S100 to be used on certain vessels to be displaced on electronic chart display information system. This is the table for requirements to forecast configuration. We came up with a very specific set of requirements to forecast configuration. That is forecast frequency, forecast turnaround time, output temporal resolution. This is for marine navigation subapplication. Similarly, we came up with a table showing accuracy requirements for key variables for water level, surface current, sea and lake ice, water density and also product format. Again, this is for marine navigation subapplication but we also noted the criteria for search and rescue mission provided from U.S. Coast Guard. On top of these requirements, there are operational requirements. Pat touched on

some of those but the stability and computational efficiency, it's very important. Computation and delivery of model product needs to be fast enough to provide forecasters and users with actionable information in a timely manner. Accuracy is important, so is resolution. Bathymetry data can be used to generate mesh sufficient for forecast guidance. Code management and also coupling, it's important that the models can be coupled with other model components such as ocean wave, inland hydrology, atmosphere and models. All components have to be community models and that has to be open source. NOAA readiness level is following NOAA project metric and measurement. Geographic coverage for navigation subapplication, it is important that the models can operate successfully in the coastal environment that cover the United States top 50 ports.

Based on the outcome from phase one model evaluation, the team moved on to phase two effort which is actual model evaluation. Based on the phase one report we selected two models which are FVCOM and schism. In the first round of the phase two report, we are conducting fairly simple model simulations for model evaluation. Essentially we provided baseline guidance just for tidal simulation. It used open boundary condition to evaluate only tides. 8 were used as tidal forecasting and the top were evaluated for assessment. The co-lead provided a [indiscernible] which lasts for three mont. The first included two nor'easter events and the second is July to September and that includes hurricane events for Elsa, Henri and Ida.

This is the study site for phase two model evaluation, New York harbor. We provided bathymetry data set shown on the left. The numbers on top of shading indicates spatial resolution of each bathymetry data set. All testers are expected to deliver up their own mesh but we acknowledge that the mesh generation is a time consuming process so for the testers who are limited in terms of time and resource, they have option to use [indiscernible] mesh which is provided by more experienced testers but they're still encouraged to generate their own mesh so that they can use the mesh later in the process.

On the right side, you can see example mesh. The top one is for schism and the bottom one is for FVCOM. You can see zoomed graphic over areas and the resolution is great for these river systems.

Outcomes from round one, the main goal of round one was getting the team familiar with the models and development environment. Some of the testers are new to coastal modelling or environment. It's for getting the testers to become familiar with models, how to learn the models and the environment. It's also for building community and training. We are trying to get the testers to the stage of storming and norming in the team development cycle. We are not showing specific results from this round but we wanted to focus on success, challenges and lessons learned throughout this round.

Success number one, communication and team building, we have hosted meetings among testers and also model developers. This provided testers with opportunities for feedback and collaboration. We also tried to maintain live documentation of

suggestions and lessons from testers and also model developers that can guide our future effort in the subsequent round.

Success number two, running the models, exposure to NOAA's operational configurations. Testers were able to use prepared script for their skill assessment, so they used provided metrics and guidelines for the skill assessment and that allowed the exposure to NOAA's operational configuration.

Success number three, conducting skill assessment, all of the model results from the teams were compared against 23 stations in the New York harbor area and also surrounding area. Those observational data were analyzed without any data filtering.

There are also challenges. Challenge number one, consistency and guidance. Testers appreciated flexibility in their configuration but they also wanted more guidance in mesh coverage, resolution, boundary conditions. We developed baseline configuration for testers to begin with.

Challenge number two, issues with DEMs. Early on in the process -- the co-leads provided updated DEM and that resulted in improvements in skill assessment. Based on that, we came up with a set of lessons learned that can be implemented in the next round. Those are essentially meetings and structure, mesh generation, DEM bathymetry suggestions and pre and post-processing techniques. Two lessons, one is meetings. Again, success of meetings has really proven that it's a good communication tool. We also have a separate biweekly gathering among the testers. This was hosted by a student. This really allowed informal and lower stakes environment for collaboration and questions.

Lesson number two, clearer guidance and consistency. Again, with the benefit of having freedom and flexibility, testers wanted more consistent guidance in their configuration. This is for us to continue to provide support, guidance and feedback to the testers.

This is my final slide. Next steps and recommendation. This is mostly about round one but the team is already starting in the second round which is about using atmospheric forcing and running the model in three dimensional mode. We're providing data from GFS and HRRR, global forcing and river forcing. We're also providing observal data sets. Water levels, currents, temperature and salinity were also testing in round two which we shared with the developers and the larger community for feedback. We also evaluated run time, ease of operation, updated models and ease of operations for calculation and skill assessment. That concludes my presentation. Thank you.

>> Thank you so much. For the last presentational session, I would like first to introduce Mr. Stephen White. Beyond leading the coastal mapping efforts, also led for the last ten years the data portfolio. This year we're handing the baton to the geoscience research division where I will lead the efforts. Before going into the modelling, I would like to link it to a discussion yesterday about the crisis and I'll start by say hello. I'm a child of NOS.

I got trained in techniques on vertical land ocean. I taught at the university of New

Hampshire. I joined NOAA, then I was elevated to a hydrographic lab where I was supervising oceanographers and learned that modelling is another kind of way of doing business. It was really fun and I learned a lot and it's really nice to see how all of NOS works together and how we work with other groups in NOAA and outside. One of the expressions I learned talking about modelling is water has no boundaries. I like that expression. It's really cool because it shows how we can connect the ocean service to people that are working with other domains. It's funny because NGS works also in the land domain. When I was thinking about it, no boundaries, what does that mean? When we think about boundaries, we think about bathymetry and water levels.

NOTE: Transcription lost for a few min

>> More of a comment, think this we have smart people, but the forecasting is critical. And I know that you are working on that and I just want to encourage that to continue and I think it is vital for safe and efficient winter navigation on the Great Lakes so I appreciate you continue to work on that and all that you do.

>> Great,--

>> Yes what I noticed from Greg and Dr. Shachak Peeri and do emphasize that type of data? And really confuse a lot about that, you know and I thought we are moving into the work and why we have them working on the title data and I mean if we have the most accurate survey we have no with crafty, why don't we stay away from this Dr. Shachak Peeri, on every chart using data. And the inference to --for example. But really emphasizing moving it from the NAV, the new one coming in 25. To the different date and that is what I want to know, what is the reasoning we can unify it with our new direction and new survey, thank you.

>> Thank you so much for the question that is a very good question. Let's look at it from the population all perspective. It is critical for navigation. We need to know the under clearance and the overhead of the gaps we are dealing with. But from the backend of the database of the house, gravity is a challenge because we are updating now our models and how'd do we remember which models we do we do? So what is the common denominator where we have everything stated? It is a mathematical --so are will is to maintain any database a reference system. Then we can do it translation to the Geo potential or to the Geoid mall so I agree not a sustainable title book of maintenance here more about keeping in a stable reference system and we go to one or new one because anyone will help with 202025 and 26 will have the tools and the information that we can navigate safely.

>> Know, I totally agree on the if I may add. I mean if --hi for example proportionate to the Geo tied to the latest Geo, that's what we need to do. I mean it is in reference to the Geo, the future on the geometry. So I'm not seeing why are we emphasizing the data and creating more data while we have the most accurate according to our survey which is with Geo ID. Why are we emphasizing continuing with 3, four title-- number I mean five?

>> DR. SHACHAK PEERI: Is a good question I'm seeing that based on application. We have the main for innovation and mean hi for navigation. And sea level useful tsunami. And the end-users needs here. So it is more of a response to the user needs here. But I hear you, thank you so much.

>> JULIE THOMAS: Juliana do you want to say anything on that?

>> No. [Laughter]

>> JULIE THOMAS: Go ahead Pat.

>> PATRICK BURKE: I just wanted to respond to Derek's comment earlier the general with the Great Lakes. We do see ice in the Great Lakes models and we have it turned off now for another year of testing. We had it on operation last year working with the national Ice Center NIC and we are evaluating the scope coming I season and hopefully will have better results. We address the problem that we feel is in the physics. And so you'll probably see a nice forecast issue.

>> I would like to appreciate that and for validate that for on-site validation--

>> JULIE THOMAS: Yes and one thing about the salinity to is that has been addressed also and has been one of the models on the West Coast of the salinity isn't quite as accurate, Derek you probably know more about it than I do.

>> DEREK: Yes that is liquid and working we manage navigation standards of the navigation standards are very different sort for so many thresholds and the broader community will understand those requirements we understand the issue and we are working with those customers and see what we can do to address that.

>> JULIE THOMAS: Okay go ahead Nathan.

>> NATHAN: Thank you for those presentations Dr. Shachak Peeri and thank you for that wrap-up that was great at the end there. I was curious to talk about the value of look, locating TSS tide stations can you talk about what GNSS is doing to reflect buoys and GN SS optometry and then talking about the updates when you talk about the effort by NGS and then the update to the NZD came up right after that, can you speak to that a little bit if that is going to be incorporated into the importance of the update?

>> DR. SHACHAK PEERI: Thank you, a lot to answer there I will try to remember all the questions [Laughter] I will start with what I remember here. The first thing, observations, yes also including here, we've been working together on the F4 research team and-- for that specific effort and we are evaluating observations for particular water level observations. So looking at the TPU, total propagated uncertainty and how that is evaluated. Looking to see where is the center of observation or what we don't know as a blackbox, having the NGS geodetic control and working with NCS also on the location and then looking at how long we need the observation based on the phenomenon. So we are looking at now the research and hopefully we will come up with the guidance and that is what we needed in the areas they had lapsed such as Alaska and the Pacific were we don't have enough observation. I forgot the other stuff I apologize.

>> [Laughter]

>> NATHAN: So tied directly to GSS buoys and then Judaic datum and that's being

addressed in the updates.

>> I will take the first doing you take the last one?

>> DR. SHACHAK PEERI: Okay we are looking out that technology so GNSS are looking at water levels and multipath and reflections at the GNSS system and it is not as accurate as the water level observations but looking at the potential to improve coverage and statistically improve our observation. So it is definitely something we are looking at. Same goes with the other kind of technologies. And again also including as-- mentioned earlier with Finasa and looking how that improve the model. And trying carefully not to double dip. If we are trying for the dash McDonald's we don't want the-- models because we will get the same answers. That is a problem we can't have. So now we looking and that technology, and hopefully we can create some guidance on how to use the different quality of technology and going back, Willie observation improve the product and I think that is in line with what you are talking about and that is what you are looking at. Hopefully will be able to communicate soon.

>> [Laughter]

>> Yes thanks. So we are undergoing the app. Underway right now and it is a challenge in itself. And wait a lot of observations we are just try to update Ray now. And with that we also have the opportunity to update both the data analytics as well. So we have two updates going on at the same time which is, it will be the last time I see this in my time. It is a significant challenge. New technologies I thank you raise that question that still under evaluation right. I mentioned in my talk at the end one of the challenges got those observations don't necessarily come from NOAA so what is going on in the community in Alaska and other parts of the country we are recognizing that just a land-based gauge is not sufficient. Because if what for whatever reasons it can be done or reasons, so we are looking these new technologies as Dr. Shachak Peeri said we want to work with the communities and understand that they can work into the products. And the products for the datum, a lower threshold to get those in but you know when we talk about the datum update and looking at the specific network centuries to meet a higher level and lower-level. So again continue to work with the technologies understanding if we can use those in the update, that still under evaluation. But between the offices and Coso rears ourselves and GS we are looking to see how to take this technology into some of our products and applications with that so people who know how to use and again with the epic as well, it is under evaluation.

>> JULIE THOMAS: Thank you. Lindsay?

>> Inc. You that was a great session and the deep dive, you know I love a deep dive.

[Laughter]

>> JULIE THOMAS: That's why made a lot of [Speaker away from microphone]

>> No I am a friend so I really appreciate that. Just the the date in the Pacific is really something that is part of my life. And partly from living there now but also working out there and trying to think of when you're out and see and no one else's author apart from space how you will get that done and I will be really interested when we

talked about how, I guess what you were saying about we talked about, using the ships and sort of sensors out there to try to supplement what you do but I guess you know in the vertical observations. I guess that is what you're saying is it needs an assessment of whether it is actually useful or not which yes I can understand that. But more generally, I think from the remote Pacific, there are NOAA ships out there doing various things whether they are co-survey related to ocean program and fisheries in those sort of things. And is there a coordination to get the maximum. It's like we talked about for mapping kind of survey once used many times. And almost should be for those ships and others that are on grants is like always observing everything that you can. When you're out there and that I think sometimes we felt like we were not as the program that was funded under the ocean exploration we are not doing enough. We could do a lot more very simply by just leveraging things. And one of them we spoke about is I think it was Dr. Shachak Peeri all the ships that are doing mapping are doing surface sound velocities continually. And give that and do the modeling. Is it useful again? You're there, there's a program obviously for the sound velocities or TDD's yes there is a way to that I don't know how many ships, some do another don't but that surface sound velocity observation is there. You know for validating those models. And that is indeed in a very small area is in the observations. And I think that is something that I would comment on. One of the reasons I comment on that is because then as a doing that hydrographic surveying in some areas, we use the models for SL and really the sound velocity is really kind of one of those last kind of things that hold you back in the uncertainty in improving that uncertainty as an example in the illusions. And I was processing some data up there from the system. And it was a really difficult challenging area where you could not physically do the sound velocity so they are trained to use a model. Model is obviously wrong. It is right on the very kind of see specific. Is there a way with the models to actually take the observation that you might make it occasionally to say okay, this is not going to work? And is there a way dynamically out there to actually update the models and improve them? So I think providing again, my comment about the observations is twofold. Number one kind of generally validate the modeling that you are doing. And observing all of what you can with these platforms that NOAA has out there but also for the operators out there with some surveying is there a way to kind of know the uncertainty of them all that you are using just from a single observation? And then predict maybe when you should be and I think there was some were done with that at Sea Con done a number of years ago the you can and cannot use those models so it is more a comment than a question. Sorry.

>> That was a great session.. Usually for that.

>> JULIE THOMAS: Your welcome and I will make a comment at the end based on what Lindsay said but I know we have a couple more here and I don't want to run out of time with the panel. So add to go ahead.

>> ED: Okay so I'm going to be a layperson. This is way beyond my ability to understand everything going on here. But obviously things keep changing. So the

question is everything you all know, is it changing because of astronomical forces like the Earth itself is fluctuating and working in changing and the sun on the moon and everything else has an impact on it? Is it happening because of warming trends? I'm sure that the waters surface in a place where the water is 100 ° and sometimes versus a 70 or 80. With the ability for you all to measure things. You can see that vertical fluctuations. And it goes back to what was done and what is causing the changing if you can answer that?

>> Yes thank you I did honestly don't think it is climate consent it we are at the end of an observation cycle. We have more observation and now we can have a model and more contiguous model developed and more accurately. In the system. And yes there are changes in which we do need to update every five years but we really are the end of a cycle where we have more observations and sampling that we can use right now and that is what improves our models and potential and/or geometric models.

>> Is what the rest of the world and the rest of the Earth is doing because as one continuous ocean at the end of the day, is that all impacting us? And do you need to measure that too?

>> We don't have to measure everything. It is collaboration and coordination and presented from Denmark and Canada here we are together to align how we see the shape of the Earth and how they see it.

>> [Applause]

>> Geodetic alignment. We did say like Denmark further save have 40 some years below but we agree that Canada and us and Mexico are having the same but this coordination is recent. This is a new effort that we now have and --unite and do some project that is international not just regional. Thank you.

>> JULIE THOMAS: --

>> Thank you, this is on the panel where I have to think it was before I ask, there is 4 --here. So have to be very careful. My question for the panelist and it is all what you are trying to get very close to displaying a real-time, the results of your modeling. From the data and supercomputers. Do you see like the digital concept will serve your course and in proper getting a result to the user in public? Thank you.

>> You. On the guy without the doctorate I appreciate that.

>> [Laughter]

>> Almost. These are new concepts NOAA. I wasn't here for the talk yesterday and I know there was conversations and this is also talk in the atmospheric community and how they are doing with the weather service and this is where we can learn from the community. You know and how to do this. There are challenges and know that there is other challenges in the service in bringing this into our domain to take a look at you know resource challenges and expertise and so this is where and others who have expertise we can learn from that and then make those decisions if and when we can use that. And I would say take a look at this and prove the uncertainties and see where we can put a perturbation in and see where we can change things. These are brand-new talks I think within NOAA as well in the last year

so we are trained to figure out what to do.

>> JULIE THOMAS: Dr. Saeed Moghimi.

>> DR. SAEED MOGHIMI: I wasn't here yesterday and but I had time to look into the text that was provided, these are very interesting idea and I think the work that we are doing here as I mentioned like Lucius MSHA like open source tools that you are developing, that give us this capability to do data-driven and the tool so as soon as we get-- TDD and updated we replicate that into our models. So I think it is not only just a copy we will have multiple clones waste on the definitions. That you are using to support end-users. So I think that is a great, great metaphor and great, great idea. But again as Pat mentioned we definitely need your been all of our support here to go through that. Together.

>> JULIE THOMAS: [Muffled sound]

>> The question you asked is a very good one and again to follow-up on what Pat said here. Taking AI is a specific example. Taking a good training set is at the moment the biggest challenge we are facing. And AI and a love that efforts are really good and in linguistics. We don't have enough examples to create a really good training data set to go through everything. So continuing what we are doing today I think is the most important mission that we have here. And having more contiguous, seamless models in my presentations that you can emulate and provide that I think is where we see us going today. I think using the AI specific example because that is a specific challenge we are facing. Thank you.

>> Yes I guess related to that the most simple question and related to what Kaseem is asking you see the models in the services on the pages and all that, are they all be provided as a service that others can use in other applications that they have? Is that part of the goal to be able to adjust them into the GIS or other applications? And that would support the digital as well. Is that with all the services part of the goal?

>> Yes, will you are talking about large data sets and how to move them. Again this is the world we are looking at the things like the power of the clap and how to, more portly I think it is how to move tools around and we want to move tools up there as well and to let people can be in their analysis and get around their. And as Dr. Shachak Peeri was saying working with the community and how to teach them to use these things so they can pull the data they want. We really made some strides in working with the ice community and those collaborating formats and ultimately that's what we want to do is that we show these large domains but for people it's a local problem. And so we really want to hone in the two what they want to use in the we can build those tools around. And we have some of that already. It is just it is more now and just understanding what those needs are, so those applicants are developing to meet your needs. But we have a lot of that ready and we talk about things like oceans map and now close serving a particular user community now and working on things like you to help forecast and things that are more specifically tailored to navigation that we talk to. So there is that dialogue, we would love your input. And what that would be to see what we can do.

>> I think providing the data and then have a goal to revive the tools is great. And on top of the other people have tools they want to use on the data. I think that is the key got to expand, you can't do everything. And so being able to allow others to do things on top of your data. That becomes real value I think. And again we talk about infrastructure and it's like this is the federal government providing the infrastructure that others can build on. Thank you.

>> Just to add to that NOAA does have a big data program I think it is called NOD or something like that where you can access through your cloud vendor or preference if it is Google, Azure or Amazon and get the formats and on top of that though formats have their own mechanism. NOAA working in the presentation yesterday a service delivery infrastructure to have all the data and register that metadata correctly so that you can find the data. But there is definitely a place for improvement so we are working in that. Thank you.

>> JULIE THOMAS: Yes that is Kim was it Kim that mention that yesterday? Yes. --

>> I just want to also mention that we are looking at the different users we have different needs and addressing all of those in the spectrum of users, and what they are striving for. But as-- mentioned again the idea of right now we are uploading complete output around the web services for access. So is really depending on the capability of the user. And how much the user would like to get involved in the process of using the outputs and you know that some countries and some private industries are really keeping, like really dipping into those data for the applications.

>> Thank you, is been absolutely outstanding panel. I mean I could speak for all the directors that we are really proud to have you guys working for us and with us. Yesterday one of the things I highlighted in my update is the --surveys we have been providing particularly in the Chesapeake and-- I don't want to put the panel or particularly Dr. Saeed Moghimi on the spot but I was wondering if you could say bit about the sensitivity analysis that we have done and that you have done to looking at how the model skill is related to symmetry and how we can identify hotspots where new bathymetry or higher resolution bathymetry is most important to improve the quality and accuracy of the outputs?

>> Thank you for this question, basically in the past two years were basically looking to address two questions, the first question is if we had a free ship today and they asked us where do we send the ship to? To do bathymetry for you to make sure you have a good impact on your model where would you suggest to go? And on the other hand how we can use the model to do the hydrograph he and where we need to support that navigation in terms of what parameters are needed. So really like bilateral kind of attraction. For them we just define a see project into that see project looking for resources to ascertain resources in the committee like Cas work or other affinity sources and trying to get the Wattles base on the opportunity. Which is different in a different part of the domain given the date of the bathymetry and the and there is lots of sensitivities not necessarily qualitative with the --maybe you have an industry and affect the current downstream or upstream of that location. So this is really an ongoing effort but I think we are onto something and

continuation of this effort will help addressing some of these questions.

>> Just to follow-up here and this is a classical example with the original high drug if he and coastal modeling play a key role together. Any key shout out for all of those that helped us with the BIL offer. Receiving \$90 million for the data collection at NOAA for the data structure act and for the coastal inundation flooding. It focused on the inland Back Bay -- is only one section and it was amazing having that resource division and NGS and biofinity and NGS and then have office-- so they came behind that collective affinity and then get the data to the national bathymetry source and then see how the separation of it that we are doing in the open open conditions impact the coastal community with the national water model and the hydrologic models coming together. So the improvement and the proven models where we have impact on land and off the land. Thank you.

>> Just real quickly. And I Dr. Shachak Peeri think talked about this but the collaboration with the mother service should be recognized. Came to them and showed the value of what they are doing with the culmination model with this. But from the beginning we have been saying of the merits of what that means. To want to lose or something and understand what that is and now they look at that as a key component of modeling as well so we talk about a lot there is a community practice that look at this coupling question and this is one of the top things we celebrate in terms of collaborating's. I appreciate the question.

>> [Speaker away from microphone]

>> So thank you for the presentation -- is a very valuable tool for both the public and private sectors in North Carolina. But we have some data gaps, and the data. I know there was some temporary gauges installed I think last year to help install and fill in the data gaps. So when will the data gaps be filled in VD datum for our users?

>> I think the best answer for that is let's talk off-line based of the data I have collected and I can give you a more accurate answer we can look at more or less Stephen do you want to answer now or are you able to come to a microphone? Just a second I will call Stephen.

>> JULIE THOMAS: To shout out.

>> [Speaker away from microphone] Caribbean and the East Coast. So that has been the pushback of the bit but it will probably 5 or six years. For that model is released. This could be a much larger model. And also taking a lot of the North Carolina data that is pushed into the co-ops as well. So we will have that included.

>> JULIE THOMAS: Write a letter here. [Laughter]

>> And Stephen said we have the data and it is of a will on the website and you can talk off-line if you want to get the data at least to see if the modelers and trying to get the update on that large region.

>> JULIE THOMAS: Okay thank you.

>> I would like to say thank you very much as a nonscientist, non-academia type person, but definitely an end-user, of the models, particularly when it comes to storm surge, operational forecast systems or in the coastal applications team. That is, it is just heartwarming as a resident of a barrier island who is inundated last year

today, I represent the recreational boater community who are also residents. Of shorelines. And this is just phenomenal listening to the coordination, collaboration and communication is going on and I applaud you.

>> [Applause]

>> JULIE THOMAS: Okay it is almost break time, Nicole are you still online or not? No, okay. I'm going to take one minute.

>> I am here Julie. I've been listening with interest, thank you.

>> JULIE THOMAS: Coming from the southeast do you have any questions Nicole?

>> No, I appreciate the comments and just sort of emphasize the need for these models. So today here in Charleston we are experiencing a higher than predicted high tide. And the communities have known this as a tide we can but they were not expecting it to be as high as it is. And we just don't have the resources. We are unprepared. You know I wasn't able to tell them to expect it to be a foot higher. So let's just keep working hard on these models because they are critical for community resilience and thank you for all that you do.

>> JULIE THOMAS: Right thank you Nicole. I'm going to just finish up with one comment. I love the presentations. What I was really looking for. And I wanted to ask lane because I know that you all know that I'm kind of a Hagler for validation and time sensitivity, etc. And in southern California we have King is offshore and we have violence and most of the models we have seen break down when you get south of --consumption California. So that's why from the Port of Long Beach we have a separate one running that's why for the MWS in San Diego they are using a flood high tide flood for the scripts. I want to point out that I'm always really happy to see what data simulation can be included. Based on what Lindsay said two, I'm just such a proponent of if there is observations to be made in the area, take advantage of them. Because what I have seen is our sand movement in Southern California is enormous. The tide in surge model, not the tide, the surge models are so variable pending on how much sand is on your beach. Whether or not it will flood. And there is so many observations particularly in Southern California, ATVs, JetSki surveys, Army Corps has funded so much coastal development observations in Southern California. And elsewhere. But I particularly note that these are data that have been collected since the early nineties. And they are online and I can always point you to them. So I just, you know, I love the efforts that we are on. Think this is something that the panel did not know that these three offices were actually working on to this extent. And you know I just hope that you also take advantage of a lot of the observational data that is out there. Because I see it as such a good validation tool. Thank you very much. If you are going to be here during. There might be further questions but we appreciate it.

>> [Applause]

>> JULIE THOMAS: To take a break and we will be back in 15 minutes. Thank you.

[Break for 15 minutes until approx. XX:05] We will get started just a few minutes. This a friendly reminder for all of the panelist and speakers, make sure when you use the microphone make sure you are not too close and not too far away. No

one online can hear you if you cannot be heard, and it is not recorded into the system. Please speak clearly and solely for our translators and for our Captioners, thank you, we will be back in one minute.

>> CAPTIONER (Jayne): Standing by.

>> JULIE THOMAS: So let's take your seats and get started for the next session.

>> JULIE THOMAS: All right I want to use this time we have 15 minutes to kind of discuss internal panel items here. One of the things that we do is to write these issue papers on topics that we feel are important. Topics that we feel the panel should address a little bit deeper. Make a statement on. And DN I will call on you because I know that you have an idea for a potential new issue paper.

>> DEANN: Thank you very much Julie. Yes so I think it was perfect timing as well after the panel that we just had. So connecting a couple of dots. Talking about the you know the models that we are building. The forecasting. Capabilities for what we just talked about the last session. Connecting that to similar conditions that are happening in the offshore and nearshore offshore seabed of seabed changes rapidly were over longer-term that are of interest to really anything that we are doing a blue economy that is in the shallow OCS, the outer continental shelf Region a specific example to kind of see where I'm coming from. From the offshore wind industry. So see waves they have levels that are designated by the regulators for industry, industry, they change daily with tidal fluctuation. Some change was storm events in the Northeast it could be a nor'easter it could be a hurricane. A lot of times we find is the nor'easters that have the impact of a hurricane because the events are built up more time.

And so this is all very relevant when you're looking at advancing some of the renewable energy, offshore wind has a lot of infrastructure that goes into the water and there's a lot of cables, buried cable. If you think about a cable it's important that is buried so it is safe for the cable so that it doesn't get interrupted and the our power is constant. Also important for all of the users of that space. Right. The fishing community and the whole maritime community that is occupying the same space. And so an understanding of how that change happens over time supercritical. The example that makes sense in my head and I will try to share with you is if you are trying to build a forecast of seabed mobility, how do you do that? You do it with this Oracle data? Will we do a high and cast to right, we look at -- line from early 19 hundreds. We advance rapidly in drastically into single beam data in the seventies, eighties and nineties whoa and now we have multibeam data, while now multi beam data we have maybe 1.4 for 40 m² area, that is fantastic that doesn't answer this question yet so until the last three years, four years we did not have the detailed data to show you know what are these features? How big are they and where are they and what are they changing? So if you try to do a high gas and figure how do they change over time is very difficult. And even more difficult than is how do you understand the change of these features over the lifetime of an infrastructure project. 25 to 30 years in the future? And how do you build for that to make sure everything of that we have a full understanding to make sure everything

of that we have a full understanding in the environment and that what we are doing makes sense. Much more data coming in that NOAA is collecting and NOAA has purview and full access to. There is also data that could be brought in from the industry or other partners.

And so that, so, I'm sorry I was just trying to paint the picture of what is going on in my mind about this thing. And then maybe ask for kind of some thoughts on what do we think could be the topic here that would be most relevant to communicate or to try to collaborate on in progress this far as an issue paper.

>> I have a little something to add to that but I won't be here but I do think it is a good idea. And just related, you know, from the economic impacts to ports. The Stockton issue that was mentioned yesterday but in addition to the on the Columbia River, send waves our huge issue there and they are in the Mississippi as well. We know anecdotally where they kind of go. But forecasting systems particularly if they were aligned with water level in all of that as far as maximizing cargo carrying capacity there's a lot of economic gain that could come out of better understanding the movement. Up shoaling basically. In federal channels for sure.

>> **JULIE THOMAS:** Thank you both for your comments. Deann, is at the understanding that is lacking right here or is it the actual measurements now going forward that would be helpful?

>> **DEANN:** So I think it is both, I think the understanding is based on the historical measurements and those are sparse. Because it is an issue where you need multiple, multiple years of empirical data to really understand. And it is something that has to be measured. And so that is this one issue. And so it can be addressed for the future as we go forward. With repeat data acquisition in areas that can really help advance at least understanding at a microscale so that you can you know, if you have a model that you can use that to ground truth a model and you know in specific locations. The perfect opportunity here is that every, every wind project offshore globally and not just in the U.S. but globally is doing these measurements. So there is a wealth of data that is being acquired in the information is being provided to-- right and that comes to another issue of sharing data.

But I also think that you know, the data that NOAA is already acquiring, absolutely is a key factor and addresses part of that. But maybe not what is already done routinely is repeat surveys of the same location multiple times and close, you know, subsequent years. And or before after storm events or things like that. Aware a bit more focused on the larger, overall aerial coverage. Because we have so much, so much work to do.

>> **JULIE THOMAS:** Go ahead Ed.

>> **ED:** Great that you brought this up, so what part of the U.S. has had more soundings and in measurements of the water then the areas around New York and Massachusetts and all of that? We have 300 and 400 years of the stuff. We have Woods Hole, UNH and everything else. And I remember looking at this data for five years ago and everybody being astounded at the size of these sand waves and the fact that they move something like 30 feet horizontally every year.

So I think you're onto something here. The whole country is flipped out over what is going on in various beaches. Where people get the cotton read currents and there is a combination of what is going on with the seafloor relative to the rip currents showing up where they didn't show up before but a lot of that has to do with the shape of the seafloor.

And I think this data needs to be gathered in one place and we have talked a lot over the last several years about the donation of data or transfer of data from all of these different windfarm developers who are really happy to donate the data. As far as I am concerned and nothing is going on with that. Right? I think maybe it that is the theme of your papers advocating or strongly, let's get with the program and move the state around and make the scientist have a chance to look at it and make some decisions.

>> **JULIE THOMAS:** Right, thank you Ed. And I know through SKIPS based on waves they do a segment model of transport. So I guess getting all of the data together could be very beneficial but also you want to know in the future what timeline they are going to be repeat surveys for bathymetry and also some modeling effort that can project the settlement transport.

Okay Nathan?

>> **NATHAN:** Yes so a couple of things you mentioned like Marine infrastructure right? And cables. So there was a Marine fiber-optic cable that was cut in the Arctic recently by ice wipeout all of high-speed Internet for all of Alaska and so there is an additional billion dollars owing to telecommunications in the state. So there is more Marine fiber-optic cables going in. So understanding seafloor mobility for those type of things. Is a lot of value and I struggle greatly though with repeat surveys versus areas where there are not mapped. We have sound waves that move the tidal cycle basis that are massive. And Juliana spoke earlier about not doing more with less. You can only do more with more right? And so we need to think about what our recommendations really are here, what the issue is and what we can do. I mean it is all really important.

>> **ED:** Yes and similar think this is a great subject and bringing that but it is how what you're talking about I think is how we connect that into part of under NOAA from the HSRP recommendation what role is NOAA in this and I think the modeling aspect is the data, the impact potentially the impact on the shore or other aspects that is having. How you get repeats I would say yes what Nathan is saying it is really hard to be a balance out the repeat surveys on one location that is well surveyed, well-well surveyed versus the areas that aren't all and for the paper making that connection is about how we make that connection. And the impacts and the economic impacts and then how that relates to NOAA is something we should pursue.

>> Sure, mainly just listening to the cover station because I think is interesting. I will note, I share a lot of the, also I appreciate all sides have been laid out here. The need for this data and to understand and be able to forecast the sediment transport for instance, its impact on infrastructure and also you know what can the navigation

services offices offer in that space? I will note that when it comes to modeling sediment transport in particular, specifically that issue, Army Corps has a lot of capability in that regard. Know whether they have a responsibility to understand and model that in the offshore zone, I am not sure. But when it comes to actually just the science behind that, they are probably better equipped, certainly that we are the navigation services to model that behavior.

But again, you know to what extent, the navigation services offices provide additional data to support that effort and I think that is a fair question to ask. And is, you know what does that look like? What resolution is required? Do we need traditional Hydro pathic surveys or can there be other means that can be brought to bear at the resolution of these features?

>> **JULIE THOMAS:** Go ahead Andy.

>> Thank you at the risk of everyone getting mad at me and tell me to go away. So this is, so this is a data acquisition system for crowd source bathymetry. Is model number one of a system that we built, we both a prototype for \$10k. Of parts. This is right now \$200. So it accepts GPS input and accepts echo sounder input. And saves the data for download later and this can be cross calibrated with trusted systems. So it cost \$200 but I think in a few years after the development costs are recovered they will probably cost about \$100. Our plan is just to give these two organizations that like the freedom boat club or some of the like that or the power squadrons in fact I think we are already working with the power squadrons to start collecting this. So cloud source bathymetry if it is a communal he did and analyzed in a timely way I think it can provide a lot of information that supports seafloor change. It doesn't have to, it is never going to be a systematic survey but a lot of data coming in from a lot of users and some of these places can I think develop and show trends and so I think this is one potential piece of solving this or helping this problem without having to dedicate shipping contract resources into full-scale surveys.

>> **JULIE THOMAS:** Go ahead.

>> Listening to all of this I'm looking at it from a standpoint of again the recreational boater. We have storms, people have outdated charts. The data on their equipment, electronics and such is outdated. And we have a storm that goes through so we know that there is going to be shifting of the water waves. You get a new boater in who doesn't understand that. The seafloor moves and they think it is just like a highway and that it is you know this is what my chart says this is what my data is telling me that it is still the same because that is just the way it is. And they are running around and polishing their props. So that as well as a look at it is also the coastal resilience, and did not Southern California do a whole lot of beach re-nourishment lately? So this whole notion of where did the beach go after the storm came or is coming? Is information to reclaim it. It is my understanding and this kind of the aside knowing that we usually have a lot of --on Sanibel that there is a shortage of beach to re nourish the beaches. So where are they going off and getting that and then what is the repercussion on that? So maybe there some titans

there, it could be purely educational and informational and a collaborative effort with the UNH, SAC, DNN and us or what have you to show people where you can get the data or how we can update it and whatever..

>> **JULIE THOMAS:** Go ahead Lindsay.

>> Yes you mention the Corps of Engineers, another comment, I'm not sure who has the responsibility who has [Laughter] oh sorry for the ongoing manus of the windfarms, I guess that is BARM that do the repeat surveys to make sure the kind of maintain prickly cables are not being unmarried and all of those sort of things. Is there something that this might be from a NOAA perspective yes we need all of that data to archive it somewhere because it is bathymetry and we should do that. But then by the recommendation and then the other agencies that is born and then what is the importance of that?

>> Yes, I thank you know, BORM and BESSY and are the ones that regular the wind farm projects. Is not just a windfarm issue. Is just the example I'm using to paint the picture. But I think it applies to all the other examples that we are talking about. And that it is a OCS issue. And it is and you know, the areas where the seabed is. Where the seabed is mobile and has impacts on the sea nourishment it comes from that sea that is offshore and onshore so that can go back offshore. So yes I mean I just think there's an opportunity here and it probably needs a little bit more work to understand what is the you, what is the specific issue that we are wanting to address and how it can be how it can be worked into this group.

>> So to comments, one is Ben is right but actually the sediment transport models that have been developed that I know about have all been corp funded. Either for coastal structures and keeping the navigation structures open right? And we actually do collaborate with Santa Cruz and USGS. And Patrick Benard. It is a great topic and I think we can certainly just in the essence of time DMT want to take a stab at some brainstorming ideas and then we can float against the panel and start getting input on it and see what we can develop.

>> Just a quick thought, Ann mention the waves on the Columbia and Mississippi issue, I would just wanted to say maybe this is a separate issue offshore which eliminate some of the issues with the Corp data instead of looking at Marina sound waves does that make sense to separate this from that? Because it becomes really coming at it, I try not to say items before lunch but the challenges on the river are hugely, we still -- to do this successfully on the Mississippi River right now I don't think we can get there from here yet. There is still kind of data alignment, disagreement between NOAA and the Corp that is really relevant. And I think that is kind of a a different metric, maybe that it makes more sense to separate the two so one offshore and one Riverine unless somebody disagrees with that?

>> I agree completely with Sean. We have the same issue with the Great Lakes with the shifting and spend millions of dollars with emergency transports because it's means of area of the area along the Erie and I don't know how you measure this in the marine environment and fix it other than I believe that will lie slowly with the Corp. If you take offshore maybe there is an opportunity to have some NOAA

engagement but inland waterways I don't see that being a NOAA issue necessarily.

>> **JULIE THOMAS:** I think we can frame it as an offshore effort to start with. And we can have one paragraph per DM that says of course the impacts and waterways, Great Lakes is different. But acknowledge them you know this is not this is the focus of this. If we go and move on, go ahead Ed.

>> **ED:** Digital twins.

>> **JULIE THOMAS:** We are not there yet. I know-- is picking up because it is not on the agenda. It is on my agenda but not on yours. Oh is the answer to that. Okay well we can include that. Is the answer to everything. Deann, let's take a stab at it and you know, if you put together some bullets and then we will just get it going. Okay? The reason why I am holding off on digital-- because I think that will be a long discussion. Gary had to step out for a telephone call. But we do have about 15 minutes so let's break into the digital twin.

So we have three issue papers now that are out there for the panel. One is the new one that Deann will be starting. We have Gary Thompson's geodesy paper geodesy crisis paper I think it is called and then the proposed digital twin paper.

So Qassim where do you think our statuses right now the digital twin?

>> **QASSIM:** Thank you I think we try to make the case yesterday with the panel and I think we have a good, we have achieved a good milestone with it but I just want to clarify for some of the people who were listening yesterday.

Digital twin is not really a new animal you know to what just a different way of doing business and observing data. And make it more reliable and more accessible or easier way to access it. My sincere hope like we build on we invested with them on the joint venture and bought --for it which is the Austin the market from endibia. I would be more than willing to volunteer my time to that joint connection that NOAA already have and the example we want to add to it, you know just a satellite example, they are modeling their for example. So I think it is really important and as a matter of time, we don't have much longer to tackle that. Just because I can assure you the future of data of geospatial data, engineering data. Scientific and environmental all going to be a digital twin. Digital is I think makes sense. You don't want to continue with the static databases and file information on somebody that is hard to drive. With the cloud capability now, everything is going to have to be served in that environment. And I mean today is no. But everybody gone that way. All the data is going to be in that form of lively rendition of the data and for the physical environment. And that is all I want to say Julie, thank you.

>> **JULIE THOMAS:** Thank goodness we have this modeling team sitting in the back here. You know but I'm sure the studying to what you're saying.

So actually, this is the Digital Twin issue paper as it is right now. What I suggest is that we reread it. And um not right now [Laughter] because I'm looking at it yes. I feel like we can update it a little bit. These down the presentations yesterday knowing what I know right now and knowing some of the discussions and knowing the reaction. I think that Juliana and Ben are probably having a heart attack on this because they are probably thinking we are we going to get their resources and

people to work on this? Where will we get the funding and standing up the new department and how we will integrate a new department? I can see that it could be a resource sync also.

Which is going to be kind of a no-go I think for NOAA right now but I'm speaking out of turn. Nathan?

>> **NATHAN:** Yes I mean I really like the idea I read through the digital twin issue paper and it was circulated earlier and there's a lot of value in the digital twins it is important issue paper put out by NOAA do think we want to strongly consider the recommended is that we put forward to NOAA and as the role in digital twins there is Julia not again making the comment, NOAA it is not competing with industry and what is the role there and so I think that is definitely a good idea to read over again and think through that.

>> **JULIE THOMAS:** Qassim, it is very generous of you to offer your time with this and I know you feel strongly about it. I do think it is a panel that would be good to continuing to pursue it and to point out a paper, I think we could revise it a little bit and really it is just from the perspective that we see it as a new technology, this is something that NOAA should really take seriously as far as seeing if there is a role for you hear what you can do. Going forward. That's kind of how I see it. Yes.

>> I agree on this and I think we talked about the end yesterday is kind of a be we need to think about more after this presentation and what is NOAA's role within the digital twin. NOAA is not billing a digital twin by themselves I don't think. So where does the industry and academia fit into that as well? We've already had the example of know the-- department and so how do you move that forward and maybe in relation to something specific to that. Maybe moving the into a port were is like putting some boundaries around what an example of digital twin could be in a port. And so is there a way to partner and have some because know marine knowledge again we don't want to keep loading onto NOAA something that isn't going to happen. But I think it is important that we mention a number of times, will what does NOAA have to do to be ready for whatever happens with the digital twin? That is kind of my reading of it.

>> If I can comment on it, I mean NOAA is already pursuing digital twin and the joint venture of finance by NOAA. So a foreign concept because they are already two years into it and that's why we need to just tap on that and expand it just instead of having the freefall satellite data. Because the data, bringing the modeling for it. I mean NOAA already embrace that I would think by going into this two years joint venture.

>> Maybe we need to deep dive during the P&E meetings on what they think is the next step with that and there could be maybe some input into like that it's into how the HSRP responsibilities and how that fits into what they are doing. I think maybe that is an area to continue to pursue.

>> Yes you are right let's take it on the side let's talk to the joint venture between-- and things and revise whatever we need to revise in our approach. Because we did know about that joint venture until recently.

>> **JULIE THOMAS:** My feeling his fellow that that NOS probably did know about either. I know there is, I'm not saying this in a negative way but NOAA is big [Laughter] and so I think that since we make recommendations to these three offices within NOS we have to be very sure that what we are proposing is actually applicable to what they might be working on. And I would love to see it explored further. And as time goes on you want some areas such as what Deann was talking about when you go offshore when you get those offshore data sets and you want to know physical properties and whatever, that does lends itself to a digital twin type set up. So think there are things whether is all NOAA industry, academia, shared, there's lots of possibility here. And I think it would be worth exploring, that is my feeling on. Galen did you want to say something like I know that your listening very intently back there. Julianna? Ben? You can put in input into this.

>> Maybe the windfarm, Deann's windfarm and how you connect the area of the two together not connect the papers to but looking for a place that you go to next instead of a port out there such a dense data set in the preparation of a windfarm in the ongoing maintenance is what really what we are trying out. You want a digital twin in the ocean then you have to support and maintain than it is, you know in a small strained area.

>> **JULIE THOMAS:** Definitely something to think about their and maybe we do reference the paper and the others or something or whatever. Do want to say something Deann?

>> **DEANN:** I want to add if Nicole is on the line if she had some thing to contribute or wanted to participate in this issue paper?

>> **NICOLE:** Hello yes Deann sorry for a bad connection there for little bit. But the area of transport and that is my area of x-rays and happy to help with that and help understand and navigate who is doing what and what other agencies are working on it.>> **JULIE THOMAS:** Great I think I already appointed you to that role in my mind. [Laughter] okay Galen does want to say something now.

>> **GALEN:** I will make it brief I think there is an opportunity for the NOS offices to look at the digital twins for some of the stuff we are resourceful for, potentially the fleet the new ships coming online, is an opportunity to explore those and looking from cradle to great all away from the beginning of the building of the ships, maintaining them an understanding you know how in our mental conditions, when they are underweight really affected the performance of the ships and greenhouse gases, and I know-- can talk about and what they have already done with fleets around the world. I think that something to ask for. I don't know that something we can move out on right away but it is something that does apply to our offices. And I think the other thing that we can offer is the foundational geospatial infrastructure for what the rest of NOAA is doing. The datum's, the foundational data that can feed into some of those other models that are developed in parts of NOAA.

>> **JULIE THOMAS:** Which is actually what you are control reading to the Port of Long Beach right now anyway. So is similar idea. Okay. Qassim, are you good with this discussion? Do you think? Yes [Laughter]

>> [Speaker away from microphone]

>> **JULIE THOMAS:** I know you would like to spend the rest of the day flushing this out. But it is our lunchtime.

So I think it is, we are going to do something with that. We just have to make sure everybody has got the comfort level there. And says the right things and gets in as we see fit. So Ed do you want to say anything? Looks like you're ready to pop out, okay let's take a break. We are not meeting back here until 1:00 PM.

Sean, as cochair will lead the afternoon session and he is an important session anyway and we will be talking about, so we look forward to that. And enjoy your lunch and we will see you back here at 1:00 PM. Thank you.

[Lunch until 1 PM]

NOTE: Time stamp is not available for the rest of this day

>> **MARK OSLER:** So if the infrastructure pieces where we have the plans and embedded plans of what we want to do, the monies will help with that. And they fall into each of the traditional categories related to commerce and transport and all of that. On the capacity building and those who have not been able to sit down and understand how the environment is changing and what they might want to do to about it. We seek to that process about and words of capacity building. So making a plan, it is further up in the maturity funnel. But this is a piece that has been traditionally difficult to get funded and has been a real success in this case. Particularly, with NOAA, interestingly enough standing at the center of that together with FEMA and HUD to some degree.

And to call out the specifics of the coastal focus. The language in the congressional direction on the capacity building, speaks specifically to coastal communities. This was not an argument about what do they mean? What kind

of capacity for home? Congress was direct on this. And so those national trends, what we do with this money? How do we administer this responsively and secure positive outcomes for the public's at the heart of the national discussion at the moment? Both in advancing infrastructure and advancing local capacity.

So we come down into NOAA and reflecting NOAA's presence as our agency within the Department of Commerce. Will seek consistent trends. There is a call repeatedly for data and information about how information is changing. But with significant call to the coast. It is significant that the Department of coastal will that are significant equities being called out in plain English. And that is powerful. And it has continued down into NOAA leadership where NOAA has a strategic plan similar to the concept of the ready nation and the new blue economy which you all are familiar with, I think.

And so again the importance of our observation systems and our predictive capacity and the support for the committees and economies that are impacted by our mission, particularly at the coast. Sit at the heart, they are not on the edges, they do not need to be interpreted from broader language and NOAA's strategic vision these in the center of that strategic plan.

So these offices all of us up here at the table, work within the National Ocean service of course. So the National Ocean services and the stages of redoing our own plan. Let me help you and to say that the central pieces of the NOS strategic plan food the climate ready nation and new blue economy and sustaining the center of both of those, those are also referenced in this strategic plan. In plain English.

So that is a bit on what the ecosystem looks like at the moment. I want to close with my interpretation of what those larger currents mean for the offices in the Nav services portfolio in the hopes that will be helpful framing for the discussions to follow with the directors.

First and foremost this is an important moment for storytelling both today and as the government steps through the process of administering the infrastructure and the inflammation reduction act. Every single one of those ultimately trillions of dollars of infrastructure benefit from our nations national spatial reference system, and will benefit from the completion of gravity and the

implementation of a deal potential vertical datum.

Every single one no matter where it falls in the nation including our territory. So this is an important piece of the storytelling that we all need to carry with us. And to the extent that we have this sustained focused on coastal concerns. Every single piece of the coastal implementation be it from the Department of Transportation or HUD or FEMA or NOAA, every question is what is the environment doing? Where is the lands under the water and where is the land above the water and where is the shoreline? How have those been in the past and where will they be in the future? Close quotes and sit at the heart of understanding the impact of environment will change at the coast. And every single question starts first with looking at the information from the office of Coast survey from CO-OPS and NGS. And broader to NOAA. And whether it is up in the broader sector, those data are the life what of this entire national discussion of preparedness at the coast.

And it is important that we ban together and telling that story. Helping those that are not as ready as we already understand that connectivity.

Second, all of these emerging needs center on these offices and the expertise that exist in there but they are not explicitly for the purposes of the safe marine and navigation. That is the give this valid we are talking about between the demand for core mission and all of this coastal resilience demand we just walk through and the money in the system.

And so there will be increased demand for data and services. Both increasing in the geographic coverage as well as the resolution or the timeliness of updates. There will be increasing demands for subject matter expertise., gosh you guys are the best in the nation, can you please come talk to us please? Can we borrow Dan Roman because we have a geodesy question. That is happening now, it is not new but the pace of change on those discussions is going to be new. It will be increasing.

And similarly, those partnership request will be happening at the individual, interpersonal level but also at the organizational level. And so as an organization that whatever scale, be it NOAA or the Ocean surface or particular program, there will be increasingly urgent demands to please become in partnership with us and help

us through these projects. Help us influence the priorities that you all have inside of these programs.

That is a very, real challenge that is emerging now and has existed but it is about the tempo and the volume of that will continue to increase over the coming years. If all of this money passes through the system. Think of all that design engineering and all of those planning discussions. The phone is going to be ringing off the hook even more so than it is today.

And I want to highlight on a particularly relevant technical component of all of this.

Which is used on the Department of Commerce piece and in the NOAA piece. A highlight on the need for predictive services. So this is going on beyond the ability to say with certainty what has happened in the past and where are we now? But there is a demand across the organization and centered at the coast with these programs to understand what is the future state of our Earth's system at the coast? On a whole range of timescales, how well do we know what? And to the extent that we have answers today, can help us figure out what they are or can you build new answers?

And so in addition to kind of just turning up the volume for the types of past demands on these programs, there will be what I see as new and emerging demands that center on this push for predictive capacity.

Which is, as we know, any bit of predictive capacity relies on our ability to understand what is happened in the past and in the present, and so there will be demands to customize our observations for the purpose of supporting these predictive analyses.

The idea of just getting double use of hey, you are doing this data collection for this reason but gosh could you flex that so we can serve this new need and that is going to happen and continue to happen. Our partners will be filling in those gaps. And who will they call on the advice to do that well and how do they ensure the handshake that their activities are aligned with and supporting what is happening here in these programs? And so both the work that will be asked of these programs directly on the technical side and on the advising side, will be significant in the future.

And because of the expertise that exists within these programs, there will be request of can use these expertise to do things you are not already doing? Things that are

perhaps not central to succeeding at the navigation mission but are essential for furthering this conversation for the nation's preparedness at the coast. And these office directors find ways to say yes to these request every day.

They are extremely gracious. Their staff, are incredibly committed to meeting this dual need. But the pace and the volume of that request is quickly getting out of alignment with what we can do given the resources that are on the table at the moment. And so I appreciate the chance for the panel discussion to dive into that in some more detail.

Thank you.

>> **RACHAEL DEMPSEY:** Sean to be going to some questions I understand Nicole has made on the line. Go ahead and go with Nicole?

>> **SEAN DUFFY:** Let Nicole go first yes please.

>> **RACHAEL DEMPSEY:** Nicole can you hear me? Uh oh! Nicole, can you hear me? I don't hear her. Okay. Okay. All right.

>> **NICOLE ELKO:** Is looks better can you hear me now?

>> **RACHAEL DEMPSEY:** Hey Nicole I will introduce you here. Our next speaker is Dr. Nicole Elko and she serves as the director of American short and beach present Association.

The Executive Director at the South Carolina beach advocates and president of local coastal consulting. And Nicole has been a member of HSRP since January 1st of 2020. And she has 25 years of experience and coastal resource management and is managed or assisted with dozens of it beach preservation products along the U.S. Southeast and Gulf Coast. Nicole understands the challenges facing coastal practitioners such as flooding, erosion and other threats so she works with US coastal communities on topics of resilience, research and restoration. Nicole, we have ten minutes for you to make your remarks, we are looking forward to it. Over to you please.

>> **NICOLE ELKO:** Thank you, good afternoon everyone. The audio is coming through good now?

>> **RACHAEL DEMPSEY:** I think we are great, thank you.

>> **NICOLE ELKO:** Perfect, thanks. So is my pleasure to be presenting to you today. Hello hello members of the HSRP. I greatly wish I could be joining you there. This is as you know a topic that is near and dear to my heart. With my fellow Ward members Nathaniel and Tuva, and and a huge thank

you to Mark Osler who you just heard from is tran one Center of expertise and the coastal resilience and of course thank you to the office directors for agreeing to participate on this panel I know is it a little bit of different set up that you're seeing here in front of you today and we appreciate you pivoting and taking the seats up front. So thank you. So just to set the stage a little bit before we go into that conversation. I wanted to remind the board of the conversations that we have had about coastal resilience over these last several meetings.

Some that may, that you may remember would include Juno in 2018, Honolulu meeting in 2022, and then more recent San Juan Puerto Rico meeting.

Then we talk about the topic that Mark just alluded to and that is just how much time one's navigation and resilience missions kind of rely on that same foundational data. But, the office directors mission really is navigation. Much more so than resilience. So that is a balance of how, how NOAA can address the needs of both through the use of the data. So it request we heard from the communities, the stories that we have heard from these communities are really um documented and brought home by the images you see here on the slide.

The images and the stories we heard in Puerto Rico, of oceanfront challenges, beach erosion, structural damages, and the picture that you see in the center is actually a more recent picture from a community in Alaska that was flooded last year by the comments of a typhoon.

And then on the right, that is a slide from Chip Fletcher's talk that he gave to us about the chronic flooding that occurs in downtown Honolulu. So all of these coastal resilience challenges have been brought to us from a variety of different communities and different stakeholders over the last several meetings. I wanted to remind you that they are all asking for very similar things. It is more frequent and spatially dense hydrographic data. So they are using you know the question that we typically ask in a way that this panel has gone for the last several meetings has been we bring some coastal practitioners forward from the local area that we are visiting we asked them, how are using NOAA's hydrographic data? They tell us anything, for providing and then they say we want more. That we want more often and we wanted everywhere. Because we need that to address

these coastal resilience challenges.

The other thing that we are hearing is that there are vast data gaps in the remote and underserved areas. And those data gaps to address them will require partnerships. And new technologies. And so those are some of the things that we love to hear from the office directors on today.

I don't need to take my entire ten minutes because the panel is very familiar with these challenges. I just wanted to take this time to flash some pictures on the screen got remind you of some of those stories we have heard of over the last several meetings. And ask you to you know put your thinking caps on and let's have a conversation here as candid as possible. About how to address this. This is not a science or technical challenge anymore this is more kind of a policy and how do we maneuver and how do we advocate for you office directors to be able to provide these data and address the needs of these communities? Thank you.

>> **RACHAEL DEMPSEY:** Okay thank you Nicole for your insight really appreciate that from you and from Mark. So next I would like to introduce our panelists who are the directors of three programs involved with HSRP. You know we are Admiral Ben Evans who is director of the Office of Coast Survey and the U.S. national high jogger for, response will for overseeing NOAA's hydrographic services including the mapping and charting of all of U.S. coastal waters as well as representing the U.S. and national hydrographic Next, Miss Juliana Blackwell, is the director of then once National Geodetic Survey. Which is the lead federal agency for positioning X abuse in the nation. And purse response will for the performance of NGS, this includes management delivery, of the national latitude, what is true, and measurements throughout the United States. [Cough] part of me, dry throat, bear with me just a second. [Cough] I thought it was only going to be a one coughed update.

>> [Laughter]

>> **RACHAEL DEMPSEY:** All right Derrick Snowden is the acting director for center of operational oceanographic product and services. And in this capacity he is responsible for CO-OPS operational observing, prediction and product evolvment activities. So. With that, I'm going to jump to some questions which should be really exciting considering we just had such a huge carb loaded lunch and I know you guys are really really awake and happy for this first panel

following lunch so directors [Laughter] how do emerging demands for coastal resilience data and services show up in your daily work? Can you give examples of new request you are getting? Are they for increased amounts of core data?

Expanding geographic coverage for new types of information? Request for new audiences?

I will repeat that because I feel I am providing a multipart interview question.

>> [Laughter]

>> **RACHAEL DEMPSEY:** How do emerging demands for coastal resilience data and services show up in your daily work? And can you give us some examples of new request that you are getting? Are they for increased amounts of core data? Extending to geographic coverage, new types of information, request to serve new audience or something else?

So I will start with you been since you are ready ready today to go.

>> **BENJAMIN EVANS:** Since I'm sitting right here. Thank you Rachael, Mark and Nicole. This is an interesting topic and I really appreciate Mark and Nichol's points around how these requests are sometimes a little bit off-center for us in the navigation services committee but I think as the conversation has shown in the last day and a 1/2, the application and requirement for these data is out there and the demand is strong. I think we have been tracking, try to think of exactly specific examples I can say. But going back to when I was a junior officer I remember getting specific request, we were out in the field doing surveys. And getting request from local managers in the coastal zone, what we currently call coastal zone managers I don't know they had their titles then by asking for printouts, of the digital terrain models and digital models that we had at the multibeam systems at that point. A got to the point where Mark Brennan and I used to joke about we were printshop NOAA. And we would have to print out these huge plots and they will come back to us and say what can you change the scale or can you show this? Can you show that? Because there was no way to share the data and any other format. That was the only way to get to them was a color plot that we could produce on the printers that we had. And that demand for that high resolution data whether it was --or bathymetry has only increase over my career, the database

that [mic cut out] portal allows people to access that data. And that was born out of those request. Because even once the data were readily available via NCEI, users got sick of having to stitch together all of these disparate surveys of different integers and having to decide which one is it in this particular area and which one has the highest resolution?

Which one of these many data sets that are faithfully archived at NCEI which ones are appropriate to my use? So by building this model which is the authoritative, curated model of the seafloor, we have hopefully started to solve that problem.

Now as been mentioned previously, we don't have, user statistics on who is using that data, that is actually not legal for us to track. Unfortunately, but we do have some indications and one I will cite is we have recently got a request when we have been working with the officer of coastal management another one of our NOS partner offices that has made a request for MVS data to support their sequel or segmentation model and the seafloor segmentation maps that directed support coastal managers and we have accelerated and expanded in some cases the MVS coverage meet those requirements. So that is an indication of where the demand may be. I think the conversation we had right before lunch about seafloor features, and supporting built infrastructure in the offshore zone, or like in the coastal and offshore zone is another good example of a ban for these data. And frankly we heard earlier this morning in the discussion of modeling.

Where the weather service recognizes and our modelers recognize that there is sensitivity and benefit to having high resolution bathymetry particularly in these instruments and the very shallow water in these-- information normally where we would not survey purely for navigation. But because of that demand, because we have been able to identify some of these hotspots, some of these areas where that bathymetry has the most impact on the model output we have adjusted our survey practices and then of course that data is available via the MVS to serve modeling and other uses.

So I hope that answers the multipart question but I think to sum it up, we certainly over the course of time have perceived the strong demand, strong demand and growing data for this. And by building the NVS very little bit now

remote from it but given the signals that we are getting from the users that we are aware of that demand is strong.

>> **RACHAEL DEMPSEY:** Thank you/ thank you very much Ben, I appreciate that insight. I want to jump over to Derrick so he can give us insight from a CO-OPS perspective.>> **DERRICK SNOWDEN:** All right thank you. Took Mark's storytelling recommended to her, that was great. No, it will be fine will be short. Rachael you asked us several yes or no questions. Or data, more places, more frequent. Yes to all of those I think is the answer. I think Mark alluded to that and that's a matter of how do we figure out how to take over what we are already doing and inflect it in any direction?

So I will steal an example from some of you may know that my permanent position is with the integrated Ocean observing systems, I will steal and the example with a CO- OPS. One of the examples is the information like Nicole said everywhere and we want all at once. Obviously we cannot afford that with CO-OPS or high precision and high accuracy and long station. So what are other ways that we can augment the system to get at new data and there has been some novel sensitive element packages as little as \$500-

\$2500.

And so is the relationship between people who are taking this information to new communities who are not as interested in undercoat clearance purpose as their primary driver but just want to know that the streets are wet. Are they standing in water? One of the other applications of that I realized was there was a community and I think it is probably a story that we heard from Nicole in Charleston South Carolina that was unable to be part of a community planning effort because they were zoned on Army Corp maps is a low rise flood impairment but you just had to walk around the neighborhood to see the flood stains on these houses. They were unable to participate in some thing that might build resiliency and the committee and planning process because they had no foundational data to say no, we actually do flood here. And I kicked off a lot of the efforts in our southern, southeastern Socorro region. And they are now coming to CO-OPS as Mark alluded to. To say how can we make this data more available and more valuable, how can we learn from you about the standards that will make this lower-cost data, still multipurpose and useful to multiple communities.

I anticipate more of that, like I don't know if it was Doctor -- or-- mention \$15 million of request for the \$775 million CRC resilient ready coast or something like that.

We heard anecdotally that there is a a lot of need for low- cost water level sensors built into those proposals. And they will be coming to CO-OPS for some sort of technical support and advice and we are both excited and nervous by that.

Because that is been with challenges you are talking about Mark.

So I wondered about a little bit there and I think the answers are actually yes. I will save a couple other comments of returning that. One other way that we can flex and take what we already do make it more useful is through the model productions that Mark mentioned and we have a lot of program there face on the panel earlier but I will state that sorry for the next round.

>> **RACHAEL DEMPSEY:** Thank you for that I just want to weigh in on one quick thing, because he touched on something that I had heard and another venue. Regarding modeling. And that is that a lot of folks that are the end- users, I think we saw some of this today, were enlightened by the modeling process and the information that can be gathered. But they know that they need data, they don't necessarily know exactly what they want. They don't know the timescales, don't know frequencies. And they are all looking for answers to different questions. Whether it is from a production capability, and investment capability. Or a day to day use capability and I think about Mary's constituency with the squadrons, you know, the recreational voters. Versus big industry, hey, what do I need to put in place? How much do I need to invest and what is that return on investment going to be for me? So how frequently am I going to have an invasion at my particular port?

So I think that is you know, another factor that we are trying to consider from that modeling perspective so thank you very much for that.

Now, onto one of the most important pieces, Juliana, the base of everything that we do, and the modeling world and everything else that impacts us from coastal resilience standpoint. What is MGS been seeing lately?

>> **JULIANA BLACKWELL:** Thank you for the opportunity to weigh in here. And I would like to maybe go back a little bit further than lately. And just say that the support for non-

navigational needs equal coastal resilience is not really new at least from the national Geo data survey perspective.

Going back to the early 2000 we were involved as was CO- OPS and probably to a lesser extent --survey and request for information about how to work within the national

ushering research reserve system. And help those particular areas figure out how things are changing and how to measure land changes you know Marsh, what is happening with the water levels? And so, it really does go back 20 years of where we were asked to participate in at the time. And this isn't navigation you know, why are we doing this? And Gail and Scott I thank you were there at the beginning of it and one of the promoters of making sure that we were providing information to these areas and to the groups and to our new stakeholders. Needed to have information about what is happening along the coast, again starting really in the rears and then branching out from that.

We found it was really important to help these groups understand what was required for the geospatial framework that they needed. Tying into water level information so that they could assess what is happening there. What is happening to the large grass, what is happening and changing with the sea levels and how is that impacting things? So it was a peripheral thing that was being done. And continues to be done and was done in such an excellent way. That analyst even. This up is something that we were to support further unlike 2010 and beyond. This was a really focused program of making sure that we were doing more along the coast with the non- navigational needs. Working and doing training, helping people set up local survey control in those areas of those nears, so that we could do the measurements, they could learn how to do the measurements, and the training exercises and training with them as well as showing them how to go back and repeat information so that they can monitor what was happening. And you know basically train them how to do work that they needed to do. And I think that at this time, or most of the nears have local infrastructure geodetic infrastructure in place so that they can do that. And then trying to tie all those things together. So what's happening in one location and how does that compare to what is happening in other places among those in the Great Lakes etc.?

There's always a need for more technical information than we have really had the resources to do. So it took a while but we did work on developing a technical memorandum or manual that would help with determining accurate elevations for the sea level change at the Sentinel change, and other areas the people wanted to check what was happening for the coastal resilience. This was not necessary in the populated areas, these were in the pristine areas that we wanted to manage.

But you take that you couple it with the fact that things are happening along the coast everywhere. And you are looking more at the bill infrastructure needing to make sure that there is accurate geodetic control. So coastal managers can also rely on information that they are collecting or utilizing to see what is happening.

Not only on the Geo that excited but if when you think about the other mission within NGS is to provide the national shoreline. So all the coastal mapping program, provides the imagery, provides the topo bathy, the three-dimensional protective of what is happening along the coast and was changing over time. And is also an important component of the non-navigational stakeholders and how they can utilize the topobathy lidar and see how the changes, and see how things are changing over time.

So this has been an ongoing thing. We see more and more applications to it. I think the other questions was are there other geographic areas? It is a yes! It just keeps expanding as we started with nears, it expanded to other locations and also not working only on the coast but what is happening inland, inland bathymetry and how the water flow impacts what is happening at the coast and tying those things together. We heard about some of that already today.

But I would say one of the most recent examples of us trying to fill the need where there was a gap of information. Was at Supple Island Rears in Georgia. Think it was just this month we partnered with the REARS to set up an operating station there at the Supple Island in order to give them new control that they can use not only for the REARS, but because there wasn't a good reference station at that vicinity. So it happened and we just at that. And we are really looking forward to seeing how that gets utilized and while we are down there doing some training with the folks there, so they can continue to use it and get accurate

information. There's probably others too, I don't always see all the requests that common. But I know that if we ask people if they needed help, and know that we would get even more request than we are able to cover.

I think I covered everything, I will save a few things for the next question.

>> **RACHAEL DEMPSEY:** Okay thank you great thank you Juliana. I admittedly, you know I'm setting this up as a kind of a leading question so to prompt some discussion for everybody. Because I want folks to know that this has to be a two-way conversation and so I'm hoping that you all are hearing what we are getting on our end. It doesn't match what you think we should be getting then I just want to make that crystal-clear.

Okay so with that I will go onto the next question. So the bipartisan infrastructural law or BIL included funding for GIS is grant band to CO-OPS to support new products like the ugly high tide flooding switch which were just will not last month. This meeting the coastal resilience needs goes down solely to funding? Or are there other factors at play which need to be understood Mac I will start with you Liana?>> **JULIANA BLACKWELL:** Think about answering the last part first, it just come down to funding. So. The funding that is going out to partners to enable them to do a lot of the work, that is really important. Also requires work on the same resources that we have in house. To help make all of that happen. And to help make sure that it is done well and resilient and continues to do what it is funded to do. So I would say the other factors are, is more work. [Laughter].

It is more work and it is all good but it is more work. And I know that there are some opportunities to have additional support to help us. What we talked about yesterday, and the day, you know, and tomorrow, you know, the critical need for geodisist us and people who understand and there is limited number of people to do that we have access to so a little bit of a challenge there. So it's great to have additional working on and we get NGS made use of the BIL funds, to do an accelerated collection of the airborne gravity. And to get a contract in place to help us establish new foundation continually operating stations that we been trying to establish now as federally owned and operated. So that is all good. And so that is we are working towards that. As you continue with the modernization effort, we also

know with the other funding that is out there, and other IRA, BIL another opportunities that we want to make sure that all of the geospatial aspects that are involved in the new work that it all gets reference back to the national spatial reference system. And only as is today. But as it gets modernized and is the new datum's and terrestrial reference ranges roll out in 25. So we are at the know this is great but with the new influx of information that will be, data that will be collected, we will make sure that it gets tied correctly to the National Spatial Reference System so that it is relevant now and into the future an individual s collecting this informational it things will change in 2025. I'm not sure if that answers your question fully. But these are the items that I have.

>> **RACHAEL DEMPSEY:** That is great Juliana and I would offer that, I think relationships are part of it as well.

Especially when it comes to the type of work that you all are doing as a shared previously know some of the things I saw in Boulder last week, I had an opportunity to visit a NIST lab and they work on atomic clocks. And I watched in front of me unfold a conversation between the experimental physicists and the geography, you know the Geodist, us and while you can get your timing down that equates to me I can get my measurements down to millimeters. Okay so as economists we eluded to earlier wire we changing this, we'll because the technology is improving and we are getting more accurate. But they did not cost any money, it was just a relationship. So thank you very much for that.

So speaking of relationships Derrick, I know that CO-OPS and the work that you do the relationships are big for that as well as the innovation what is your experience here.

>> **DERRICK SNOWDEN:** Okay you set me off and is lightly different direction here.

>> [Laughter]

>> **DERRICK SNOWDEN:** No, I will get to that. It is an exciting opportunity but as you were alluding to Juliana there is expectations for how the work happens inside that we might not be able to meet or that will take some significant changes. But let's focus on the positives for a second and building off of that modeling because I see he is want to say something but I'm going to steal it before gets there.

>> [Laughter]

>> **DERRICK SNOWDEN:** Because both of our teams are

working on this. I have a little crib sheet and this is a Google document we are working on with the team over the weekend and late last week. And in this part of the discussion we had a long comment thread, where people, the team was putting and examples of the BIL work that we were doing and that we are really proud of but we were not quite getting, is it just about funding? Is it just about money? And finally I was pressing on that and one of the teams is like yes that is the main work we are doing for the BIL will set us up for a new product line that we might not be able to continue. In 2026, after that funding dries out.

Again focusing on the positive what it will allow us to do is building on some of the modeling work that you talk or that you saw this afternoon. Extend, I think it was the news she was talking about. Or maybe about integrating the land and the ocean models and one of the main thing is that we would be able to deliver without funding is coupling between the ocean models that you saw on the slides with the national I remodel so we can start to add and hydrology

+ wave when driven surge and that sort of stuff. On near- term timescales. And that is a pretty exciting to moment we have been pursuing, NOAA has been preserving this water prediction for ten years now and this is finally getting us to the point where we can make good on that promise. And we think we will be able to deliver this those productions into the time that the infrastructure funding runs out. Then what happens. We don't want to have a new capability, we don't have the ability to continually update and infuse the science and innovation and so going back to the partnership question. As we are looking at what does it mean to couple those ocean and land models I'm pretty near-term timescales that are relevant to navigation services and surge predictions for a storm that will be here tomorrow.

How can we turn that into more longer term projections that help us prepare for things that might be 10 or 20 years, mine? How can we start to extend our navigation services productions into climate timescales? I think that is the missing piece right now. And that might not be a capability that we have at and illustrate know a lot of that foundational work is happening at NOAA and other government agencies, big large-scale open ocean and that is a partnership that is limiting us and how far we can take that. It is little bit more than just funding. I think kind of is

the answered mostly that you want me to give their.

>> [Laughter]

>> RACHAEL DEMPSEY: I think that is pretty great neutral answer. Well done. Where do you see?

>> BENJAMIN EVANS: Thank you for taking, I can't claim that was really my answer but Derrick said that, if I sound him you know why.

>> DERRICK SNOWDEN: [Laughter].

>> BENJAMIN EVANS: I will echo that point that money does not buy happiness but it sure helps.

>> DERRICK SNOWDEN: [Laughter].

>> BENJAMIN EVANS: Echoing everything that Eric and others have said I think I would add to that and say that there is an omen of awareness here. And I alluded to this a little bit earlier but and perhaps in my, from my remarks yesterday, that the BIL money, the and the work that was expected to be done with that money . Did not have, there was nothing in that law that said go resolute that law in the them entry, in these areas there was nothing in there that recognized the value of value of geospatial infrastructure to the it was only one that money got to the weather service and there was a recognition that oh eight, if we have to do this we have to go back to our partners at NOS and get that data and then we have to parts off a little bit of that to come over to us. To support them in the effort. And I think that yes you know money is a big part of this but also awareness that the work that our offices do. Is foundational to that work. And that those resources exist. Right? That there is this thing in our case that there is this thing called the national bathymetric source and we have built that with the explicit intent of supporting this type of work. And because as we noted the BIL is certainly this huge infusion of funds that will move us forward and very real ways. But it was going to run out. And we have to have the pieces in place, we have to have the infrastructure in place in our offices to sustain this availability of data going forward, long after the BIL has expired.

>> RACHAEL DEMPSEY: All right. You very much oh, Juliana please.>> JULIANA BLACKWELL: I just want to make sure you are all aware that the BIL money going to the National Weather Service and again with everything that Ben was saying how it wasn't really thought out about the foundational data that was needed for that, the reason we

were able, and very successful at getting some of those funds from the weather service is because of this man right here. Mark Osler. And we had not had him going to bat for us and communicating very strongly about the needs, we would not have been successful. And it was because Mar could tell the story and have those relationships and have those other parts with NOAA and come fight for us to make sure that we have the funding we needed to get the work that we needed to be done. And we really appreciate you doing that mark. And you talk to us about this and you know, a little back-and-forth but it was, it was... thanks to you I want to say that. And just talking about the other work being done for BIL, not just BIL from our perspective but the money that went out the door for BIL for all live these other projects that we don't even really know what they are. And the other departments and other parts of the country. No idea.

That as a kind of thing that scared me, like what is being collected? What is being done? And do people know that technical things that you know from a NGS perspective it needs to be part of these projects and then to be sustainable and usable in all of those good things. I will stop there, thank you.

>> **RACHAEL DEMPSEY:** That is a great approach Juliana and also give a hat to Dr. Shachak Peeri because I know Dr.

Shachak Peeri had a part in that you.

Wild on to the next question and this time we will start with Derrick, so giving you a heads up here. How might NOAA tricks and relationships with the ports and the navigation community to understand the things like sealevel rise under operations and what data or services would be most useful for them? Over to you.

>> **DERRICK SNOWDEN:** So given my two weeks of experience with this community, I'm going to go out on a limb here a little bit.

>> [Laughter]

>> **DERRICK SNOWDEN:** Let's see, we were talking about one of the things that occurred to me after the fact I think I was talking with someone about the data that you are collecting under your normal operations and how can we use that as a partnership model for sharing that with NOAA? I think there are some opportunities there for building on existing relationships through the weather service volunteer

ship program and the other culture programs and this is a we we have funded volunteer mariners for many of years. One thing on the partnership model was that. The thing on the ports. This is not only a new idea for me but I believe it is somewhat new for NOS, and Nicole talked about yesterday where she was alluding to kind of reports and she said I want talk about it too much right now but I will tell you the next time I see you. So I think we are sort of formulating what is our ability to engage in the conversation?

I think we have ideas of what and how our data might be more useful for preparing for changes in port structures. But I looked into one paper on the topic and it just struck me that they said the fundamental limitation was it takes 10 to 15 years for the decision to change for operations. These are slow-moving, highly leveraged organizations. And highly political. That really will push us to what sort of information we have today might help you think ten years from now. Know how to help you think about tomorrow but we don't know how to help you think about ten years from now. It is our priorities and assistant administrator. It is our priorities and assistant administrator party so we will be leading and through that and to pull together a stakeholders services branch to solidify our approach to the stakeholder engagement and I believe that this area will probably be high on that list of things to focus on initially. So passing along.

>> **RACHAEL DEMPSEY:** Okay great, Ben?

>> **BENJAMIN EVANS:** To the point about strengthening partnerships to the courts community, and to help that to a conversation of hoping them understand the impact that they may be expressing and helping us understand how we can better support them. I think it is a question in large part of continued engagement. We have strong relationships and building relationships with organizations like the American Association of Port authorities, which co-opts has over traditionally really taking the lead on that. On that relationship. And we have strong relationships with the Marine exchanges. Your American pilots Association. A number of these organizations that represent different components of the maritime economy, the maritime immunity imports specifically. And frankly, I want to point out that the HSRP as part of that. Right? I mean this is part of why we take this show on the road and go to coastal

communities, go to the ports is because the power of this body gives us tremendous, meaning power. To bring all stakeholders and. Because they want to hear from you, they want to be part of this conversation. So I think that is a real superpower for us.

On more kind of a technical front. I think we are really in terms of what are we able to deliver to the port communities, to the port infrastructure? We collectively are on the cusp of delivering really some incredibly new enhancements and I haven't said, will be at least ten minutes since I have said precision marine navigation so I will say precision marine navigation which is that collection of high resolution data sets services in this new S100 framework. A truly is the chart of the future. That collection of high-resolution real-time data that produces a single combined operational picture for mariners, and you know so how does this relate to resilience? Real really integrating us into that picture and integrating this picture gives us the really to talk to, to get the most value out of the infrastructure that we have at the ports. It increases efficiency and increases throughput and what does that do? Reduces the impact, when you do have some porta base into the port that causes restriction or causes friction or some other factor having a full understanding, not just of that particular port but of the entire network of ports and allows us to do some load-balancing and distribution and that you would not be able to do otherwise. To again, react to those privations. And none of that is possible without the full integration of the metric at water level, surface currents, weather all of those things that we talk about when we talk about precision marine navigation.

>> **RACHAEL DEMPSEY:** The ability for us to put the information to good use is really cripple. The actual excess million availability of it to those that we are trying to reach. So I think that is one of the biggest challenges that we face as well. As you know closing the feedback loop and so you all are absolutely a huge help in getting that for us. Juliana, you want to respond?

>> **JULIANA BLACKWELL:** Sure I will add a little bit. Maybe, not specifically just with ports communities but I would say all communities and Rachael and you are in some of these conversations yesterday at least with some of the other observing system work that you do. The thing that I see

mostly from an NGS perspective is the sea level rise, the level change that is being monitored but also a news to be tied to land. And the land changes just like water change, just like the water heights change. So we certainly know in certain parts of the coastal areas as well as inland areas there is some subsidence or subsidence depending on how you say it.

But there's a lot of data and technology that we can continue to bring to the table. To help us as a nation understand better what is happening with the land information. And is something that plays into all parts and most of all along the coast and in all places to see what is changing over time and because of how land changes it can affect what happens with whatever happens with the sea level change as well. So there is, on the technical side there is those pieces and I think that as we look at how, what do we do in the future with vertical land motion? Deformation modeling and changes to land. This is something bigger than NGS this is something we are working with NASA, working with USGS, working with other parts of the government because you know we all have a piece of this to figure out.

And their satellite technology that we want to be able to utilize. And is years away from getting there. But there are little things that can be done now to help us identify areas we can do pilots on and we have done some of that as well. So again all of that will affect not only the ports but other places and I think that that resulting in the what is happening with the land whether it's natural or man-made changes that are affecting elevation changes and should be brought into the discussion as well as other federal partners who are part of the solution, or not solution, but part of the, are partners in developing new products and help people understand what is happening the local community's. And do you want to say anything about your mask will or looking at years to settling needs and things like that. But that is just what I was thinking about.

>> RACHAEL DEMPSEY: That is okay.

>> [Laughter]

>> RACHAEL DEMPSEY: It is okay [Laughter] I will let you guys in on a discussion that Juliana and I had yesterday, I had to duck out and go to NASK a meeting which is in and there is some decisions, around . They. Us yesterday on the

satellite needs working and long story short the number one need is for vertical height data. It did not get funded. And ready to come up will be number one again. Which is very exciting for us. On that side of the house. So certainly you can advocacy is strong for this and we work on this to the ports and the navigation. And you know just to add to sense you know having been a resident of Norfolk and a resident of San Diego, I can attest to the shifting near our feet near the ports infrastructure and it is real and it has been happening for a long time and it is causing challenges but you know, like all of you, your life is on the coast. You cannot pick up and move so what are the things that you do to manage those changes?

And what are the small bits that of infrastructure that you can address and that all has to be informed by the work that you know, these three directors and their teams are working on everyday.

So we are at 2:08 PM and this group has amazing questions so I want to make sure that we have enough time to answer them all. Because I think we are supposed to wrap up at 2:30 PM. So I would be happy to open the floor to questions. If the board has any. And Nicole and Mark, obviously the questions you guys are free to answer questions as well. So everybody is fair game. All right.

Who wants to be first? Know someone has some burning questions.

>> Go ahead Lindsay.

>> **LINDSAY GEE:** One question has been mentioned you know that started with no chart and getting request for that and so we have seen over that time They will change in technology which has put a reload on oil offices anyway just supporting the navigation services requirements. So that is a big change and have to change that. And also heard about the geodesy crisis and generally the workforce issues. So apart from getting the money now which is obvious a great and getting that done, how are you planning to address the workforce issues I guess in the type of people that you need to move forward to make sure that you maintain that full commitment to supporting the navigation services?+ all of this extra kind of requirement which is important work that needs to be done. So is a loaded question in a way. And how do you see using industry to support you in that as well?

>> RACHAEL DEMPSEY: Tough question. It's all good, anyone want to take a stab?

>> LINDSAY GEE: Without the industry part will be okay.

>> RACHAEL DEMPSEY: Go ahead Julianne.>> JULIANA BLACKWELL: We do plan for our staffing needs and see what we need to complete to address the mission that we have. The future nation that we see and for example, instar data, we know that we need to get more involved and what is happening with instar and utilizing that and being able to use the research and understanding that. We don't have the expertise in that area. Do we need the expertise? I don't know. But if we have the ability to bring somebody in to work with that, work with them to figure out how instar data can be utilized with some of our products that will be great whether or not that as a long-term staffing need to be determined. But we know that that is a technology with that we want to be able to really utilize and we are not alone. We work one part of the federal government that is involved in this. So we look at our, 100% needs for staffing. And then we go okay will we know we can't afford all of that. So then what are we going to push off into the future and what are we going to wait for? And what do we need temporarily from probably from a contracting perspective to help us give over some, you know goal that we have and then figure it out from there. All of our offices go through an annual or biannual staffing you know. I would say need to. Versus ask. Because we don't have enough of what we need let alone learning how to ask for more of that. So is something that we do on the planning side and I think there are opportunities for supplemental funds or just for particular projects to do that and contractual services to bring in experts that we need. But it is not a long-term, it is usually not a long-term solution for us. And if that touches on anything that you are looking for.

>> RACHAEL DEMPSEY: Thank you Juliana, any of you want to weigh in? Okay. All right. There we go. Julie?

>> JULIETHOMAS: [Speaker away from microphone].

All right, follow-up on what Lindsay just asked, sparked by what Mark put up on the slide, I can't remember exact wording but it was increased customized products, increased request that might be coming in in the future I think was pretty much the just of it.

My question is... and I've had to deal with this in my past

history as well.

Like at what point? You can't make a product for every specialized request that comes through so you have to rely on or my feeling was or how I approach it was I decided on some standard services, substandard products and we said okay, this is what we have.

I don't know, how are you handling that? Like as custom products come in? Do you have a standard products and then you send it back to them and say look at will pay for this yourself or something? Or do you say let me get back with you, you know I will assign a person to that and see what we can do? I mean it is like, to me, it is a little bit of a decision there like how much do you provide customized products?

>> **RACHAEL DEMPSEY:** Julie I'm going to jump in because I think that is really awesome question it is almost self- preservation, we can't answer everything, you don't have the bandwidth nor the number of people. You know. I would argue nobody does. So how do we manage that? So Mark, do you want to take a stab at that? [Laughter].

>> **MARK OSLER:** Understanding I don't produce much right? These are the themes behind these folks.

I will say, there is, I think a natural alignment towards commonalities sort of basic foundational set of data. That the data that comes out of NOAA in the space and many others is not only potentially customizable and relevant but it also carries a stamp of authority and kind of the buck stops here for certain parts of the data sets. And so what I personally think I see across the agency is a commitment to making sure that there is commitment to open data standards. And that we are providing the foundational pieces that can then be customized. Well, primarily by private sector. Yes.

But I think when I was inviting us to anticipate was particularly on these offices got the nature, if you were to put a requirements document to make a predictive model to do X, and what are the observation needs to support that model? That is a different requirements list then what are the needs for that same type of data that to the right person it is just ground elevation, it is just water level, right? There is-- so what degree do we need that? It is possible those request come from NOAA Rams, from operational outputs the other parts of NOAA are busy with. Which is a

different type of request, or external government partner whereof, these are the things that more of but these are some of the things I think I'm aware of in the space as it exists today.

>> RACHAEL DEMPSEY: All right then do you want to attempted?

>> BENJAMIN EVANS: Sure.

>> RACHAEL DEMPSEY: Okay [Laughter].

>> BENJAMIN EVANS: I think our goal is to get out of the custom products service business. The idea is in the case of bathymetry is to provide that data in most cases at the highest resolution that the sensor will support. To support and to build our work close anyway to lead to a nautical target another never get in product but preserving the whole data of that data and as far as we can and hooks into that for uses for other folks and purposes. So the highest the resolution will support with uncertainty associated with that and on a defined data and then, shoot there was some other point I was when to make about that.

But presenting in a way that is known to be authoritative. Right? And then the user is free to go and take that data and produce a custom product that meets their needs. I will also say though, that and I recognize this probably is not quite where you are going with this but recognizing that users do have requirements to visualize and utilize data in different ways. The custom charter tool is a good example from a navigation perspective of how we are providing the means for users to reach into our ENC database and produce a product which is built to their needs and to their specifications. So what I would say you know bottom line are at or position is that we do not want to be in the custom product business at all. When it comes to navigation products, we have a slightly different approach.

>> JULIE THOMAS: Even then it is limited your building flexibility and saying we get asked for this and this so let's make a custom, you know to allow them to do at. Because when you have some off-the-wall requests still that comes in. That is the key. Okay thank you.

>> Can add one more thing Julie?

>> Mark and I were talking about last night I would try things. And I can certainly resonate with that. Your question got me thinking about was I wanted to answer exactly what Ben said then I was thing about the cover station with Mark

and I was like yes but there is not a clear line, there is a separation between that sector and the operation world, one of the concept between -- economy, there is an emerging market out there that we just don't know exact what it is yet. But we expected to be big.

And then the weather service I think the boundaries are a little bit more clear and there is an offshoot of science advisory board that focuses on sort of defining this public and private partnership. And they describe as this moving wave of the boundary. Like the government will have to push out a little bit to develop something and then it is marked and we step back and then just provide the data. And someone else is building the service on top of that. I don't think that has taken hold in the new blue economy just yet but we anticipated there.

And the element of that that I think is relevant, I think we are always looking for ways to support ports and to support in-line. But one of the ways that we can attract interest is to show utility to new things, so the high tide flooding in the bulletin is kind of one of those, it's an innovative product, we designed in-house, it serves a purpose and we are getting great feedback on that. Is that inherently governmental function or is that an opportunity for someone to market later? I don't know. For now it helps to show the a support to keep it going to let people can build on top of that.

>> **RACHAEL DEMPSEY:** One more minute because Sue is waiting very patiently. [Laughter] it's all right. No, please go ahead.

>> **JULIANA BLACKWELL:** I was going to mention again that we don't want to get into the business of custom products, we do provide opportunities for stakeholders to give us feedback through our alpha and beta releases of a member of the products tools and services. We are asking, we've identified things that we plan on building and then when they are at the point where we want to see how they are working for folks to put them on our website and then you know, advertise that we are looking for input from our stakeholders so that we can two things. And it is the stakeholder feedback.

>> **RACHAEL DEMPSEY:** Thank you Juliana that is really good point. Another avenue for us to get that feedback and respond. All right, Kassim thank you for waiting.

>> **KASSIM:** Yes what I wanted to ask, the idea came from one Mark talked about customization and have it all for the private -- to take over. I think this is a great idea definitely. I mean we all understand NOAA should not be great, we agree on some products because where will it stop? But think we need to answer to look into that relation. You know through PPP. Because if we just say the public can go down below the data and they do what and then they come, maybe we can moderate that discussion, you know bring people around the table. Give us an opportunity and so it's a yes for NOAA to highlight what kind of less specified 2 or three product, could be taken into commercialization for example? Once they do that, they did that with-- Mask and other, so-- has the potential to take it from us and we work with you and support you because that is what the private investment, and we need that insurance, and need to invest money in a project like that they want to go off the back of NOAA. So I'm not sure the best faith, through the contractor maybe, through BPP, that's all I mean, thank you

>> **RACHAEL DEMPSEY:** Thank you, appreciate that. Okay Nathan.

>> **NATHAN BIRDWELL:** Thank you I think I have more of a, then a question. Well you guys know me very well and has related to datum so I read through the title of the session, the coastal resilience planning and the U.S. using NOAA's flooding, in addition, sealevel data products and services. A phenomenal model for multiple reasons. Currently we don't have those coverage in Alaska with the be data and current active plans to develop that. Because of that the coastal resilience planning that is conducted in other regions of the nation, don't have those tools to do the coastal resilience.

But beyond that, I mean, so the foundational data that is collected by each of these offices, goes directly into the development of the tool and that program just as the coastal resilience. Bathymetry goes into the model, tidal modeling goes into the spatial model and referencing. So appreciate the work so I appreciate the work and please continue.

>> **RACHAEL DEMPSEY:** Thank you for your support, very much. All right, anyone else? Any questions for Nicole? [Laughter] Deanna?

>> **DEANNA:** I will continue on my theme of mobility here, my question Nicole, sorry Juliana, is the idea of a reference

seabed level, is that something that has come past you as a bench, benchmark? And the nuance to that is, and I think what you know, this group does is actually the opposite is kind of the higher points rather than the reference, the seabed level. I see that is relevant because for a whole number of reasons but it ties into you know what I have been talking about which I will not talk about. At the moment. It is also relevant to all of these changes that are happening along the coast. That there is some level that where it doesn't change at the same rate that is changing above that. And in some industry that is referred to as a reference seabed level.

>> **JULIANA BLACKWELL:** I'm not aware of that term by was a for the National geodetic survey I would say we are on the dry side answer.

>> **BENJAMIN EVANS:** I'm not from there with the term either so I might not be answering the question you're asking. But perspective on that as we were talking about this topic before lunch I was referring back to my earliest days in almost 25 years ago doing hydrography and Long Island sound and doing these enormous sound waves. The way that we portrayed these and really the only visible product of our chart was sound waves, the mariner did not know --need to know is only what sound wave was, by notating those the mariner will know that those sound waves will migrate year to year but the height of the sound wave and the players to them was probably unlikely to change by a whole lot. And that was the way that we had the communication of the results of our work at that point. There was no MVS, not even in NCEI, although it wasn't NCEI at that point. So I think now though, and again back to this idea that of preserving the highest resolution that the data will support as far through our pipeline as possible and building access to that, yes we have a navigation product which portrays that data in a way that is useful for mariners. But we also recognize that there so much more value in the data and to now have a means of sharing that with other users, I would assume and maybe I'm not understanding again, what the requirement is here. But the resolution of a sound wave, you know, that is fully resolved at least you know these macro skills anyway. It is fully resolved in the data sets that we are providing.

>> **RACHAEL DEMPSEY:** All right thank you Ben and Juliana

for that. Open up for one last question if there are any? As Ben tells me they have 38 seconds. [Laughter].

All right. Everyone thank you very much. I appreciate the engagement and the opportunity to talk to you about you know, the efforts that we are doing here. I just want to remind you, please you know, continue that open dialogue with us. And the snow what your thoughts are and what your concerns are we, you know we always are here to learn. And meet our customers needs. So thank you very much for your time.

>> [Applause]

>> Rachael I would like to say that you did a great job addressing and moderating and covering everything. Well done, thank you.

>> Members of the panel we are getting together for public comments. Just give us a minute or so. To get underway.

TigerOS I understand we have one public, that has been previously shared as did yesterday, I will turn to Virginia to share that comment and I will also have five minutes for any comments from the floor.>> VIRGINIA: Okay just one public comment yesterday from the round-robin. It was from Pamela US Coast Guard auxiliary. And it was FYI-- contributing causes on pitch 20 of 2022 U.S. Coast Guard loading statistics report top, I guess, fatality is alcohol use.

And that is it.

>> And that is the top one for sure that our five top ones and operator inexperience and whatever also. So thank you very much.

**B r ** So is there anything further in the inbox? Okay. Do we have time to open the floor for public comment from the audience? Okay. Then I would invite any members of the audience here in the room who would care to make a comment to approach the microphone and do so.

>> Hello everyone I am Brian Meyer. I just wanted to let everyone know that there is mention yesterday of the NCEI, if you are interested in more information about the activities that NCAI you can sign up for newsletter at NOAA/NCAI.

>> **BENJAMIN EVANS:** Thank you Brian, anything else from the floor? Okay. Then I will turn it back to Julie.

>>**JULIE THOMAS:** John.>> SEAN: All right I'm going to be duly for the rest of the afternoon. Anyone on the panel have any comments or otherwise we are looking at a quick break

before the next panel any, Captain McIntyre.

>> **CAPTAIN MCINTYER:** Just a quick comment while I still have access to a microphone not related to the panel. But the first thing I want to say is that this is the first maritime related conference that I have been to weather is a perpetual line in the ladies room. [Laughter] thank you for you know pursuing that diversity on the panel I think it is awesome. [Laughter]

But secondly I just wanted to pass along after our workforce conversation that we had yesterday I reached out to the Maritime Academy and received a response this morning from the interim president of the school. And I just wanted to read the email to quickly because of all the workforce for this issue. As you know CAL maritime has been experiencing declining moment since the 26 teen and we are not a load and this is other state airtime and canopies as other merchant Marine Academy all report troubling declines in enrollment. Background. This is a national wide issue and is going to be exacerbated by the demographics from 2025 and beyond.

Demographers tell us that the trades in the U.S. declined in 2008 after residue the highest level in two decades and the decrease seems to be ranked to the recession from 2007 Through 2008. I suppose in the USA are now feeling the impact of reduced high school populations, this impact will soon be felt in colleges, universities and the military for the foreseeable future. Is all pulled from the same demographic. I recently met with our yes Congressional representative and asked for federal assistance with the nationwide marketing efforts of the maritime academies which like the military employees. If NOAA leadership also raise the alarm for Congress, it would help. Further we are hosting a career day on October 10th and have been invited partisans from the Texas sector, the U.S. agencies, NOAA is sending to recruit or to the campus for career day.

Additionally if the NOAA leadership would consider a accredited NOAA officer for assignment to maritime for a 1 or two-year assignment as a NOAA faculty member we would be pleased to have that discussion. Having a NOAA officer on faculty would help with recruiting efforts. Just generally about the California State University system there is seven CSU campuses right now that are not meeting enrollment targets. All of them are in the northern part of

the state. CAL maritime info trailer only has 763 students with a capacity for 1200.

>> B Thank you, anyone else on the panel otherwise we will go for a 15-minute break, start back at 3:00 PM. For real. [Laughter] you are on break.

[15-minute break until 3:00 P

>> Okay.

>> SEAN DUFFY: All right we will kickoff the making sense of sensors alliance slides. Presentation. So making sense of sensors I will tell you has a start HSRP with Admiral Rick Brennan. And these mentions he was really a endemic force and he made a lot of adjustments that we are talking about on the Mississippi River. And making sensors, sense of sensors Alliance after the discussion with Rick Brennan time a how we had differences in the datum's and differences and how we calculate things and sensors. And I was talking to Rick, me is like look, the inclusion with the Corps of Engineers and NOAA is always been one of our talking points. And a place where NOAA interactively with the Corps of Engineers on the Mississippi River. Physically I talk to the government agencies. So there was NOAA the Corps of Engineers, US Coast Guard and USGS with pilots and will you participate in talk about the issues we have related to different things and how they impact with sensors. And everyone was generally excited to participate.

And in many ways, today's session is not true to the making sense of sensors alliance. Although it shows progress that has been made because of discussions. And we did make some changes.

One of the USGS current meters, we are one of the only current meters USGS ship channel, but pilots did not even know it was there because it listed the metric in fee per second. In the sky, making sense of sensor alliance Sean Duffy said you know hey that cubic feet per second doesn't really help us at all. Could make it miles per hour? Enter the group easily what they said is yes, we can put in the miles per hour, would that be helpful to you? And we are like yes. So now we have basically that current meter and the message of USGS was we understand why you needed it in feet per second and that is your metric, you can also write a program and how we provided in both numbers on your screen for your office use. That was what we started and it

led to discussions with the USGS with the nature Conservancy. Which we will have a presentation from one of the major sensor effort coming up. I really just wanted to talk about how this started because of that movement and as we continue with it, we are seeing adjustments and a lot of discussions about NOAA ports and sensors that made sense. With that I will start off, Chris do we ever get you? We had some really good airgap sensor slides.

And with that I will introduce my friend Doctor Thomas Butkiewicz I said it better a minute ago. But you will introduce talk more about the sensor.

>>DR.THOMAS BUTKIEWICZ: I prefer to stand up here. Just let me know when I can go.

Okay so we will share a little bit off about how we can take all the data that has been gathered and making more use out of it. To improve the data products that are viable for navigators. So we know that there is much larger vessels coming through the Mississippi that are often using 99% of the available Air Gap under these bridges. So is really conical that we provide accurate Air Gap values to enable that safe precision navigation.

So the way it is done right now is for these different bridges, you will have-- and a certain number of feet and then you go find the appropriate gauge, track that number and it tells you what the Air Gap is.

If you are really lucky you are going under the two bridges that have Air Gap sensors so these microwave or laser centers will ready with a real-time clearance data but only two bridges have them and this is the way it is presented on Corps. You see there is a single reference value and that is the single navigation span. That is the one number you will get off the website.

And then you can just bring up on your mobile devices to get the value. The problem with this of course is that pilots want more detailed information on this. There is a lot of request to improve the existing visualizations that were available in PORTS and a lot of questions that come in about how they calculate clearances and what gauges to use.

This is really big issue so there was an accident a few years ago were a barge slammed into the sunshine bridge and that shut down the bridge for 49 days and caused \$7 million in damage. It could have been a lot worse in the bridge could have collapsed would've been really catastrophic.

That extended from the back of the navigation only list the navigation for the clearance band and not the secondary spans. And the NTSB's report they recommend that NOAA update the clearances and publish all the clearances for these values. And we demand for additional clearance data. If you look at the feedback they want to have additional detail on that detail inside of the span. So that they know they have a few more feet in the center of the span the night reference point, that still point so really should get more information about that.

Another challenge is that is all sorts of nonstructural things that hang under the bridge, the lights and wires and things like that and those can be changing. So how do we accurately make sense of a loose information and present that to Mariners?

And we thought we can use these great lidar scans, so Rick Brennan brought these to us and this is part of the navigation study for the lower Mississippi. They are very detailed and about 60 million points for those spans are there.

And things to the recent order, this is now considered authoritative and you can use this to calculate bridge clearance space.

We have used internally at CCOM the ship simulator at Mississippi or and you can automatically quickly clearances to the span above you to the nearest filing and if we have -- like we can call you lately clearance as well. It is far more complicated than we need to make this. We class the down to 2D by projecting all the points along the bridge travel and then reduce the dimensionality further to one dimension by finding all the minimum heights and kind of a contour line under that bridge.

So we have two methods during this one off the shelf cloud technology using cloud compare we also wrote our own script for that. It reduces the capacity of the data from 30 to 60 million points down to 1 to 2000 points which matches the display resolution that the end-user will be using this on. Both users are having check it out if you are working with 3D print close. So the cloud compare this is how we collapse the data and move down the sides if you want to see the full details. It is detailed and sourced and very accurate and generate the images in their. A little clunky, it was not really designed to do this.

So for that we built this custom huge QGIS script. And you just draw a line that shows the direction of travel of the bridge and then takes care of the rest and calculate all of those values and generates images for you.

So what you get out of it, a data products are you get 2 JSON text files that contain these lines and text and these are easy to reference so these can be generated from the color lidar or they can be a photo or a CAD drawing or what you already have on PORTS. This is essentially what we have drawn with that. This is on the ports website. Allows you to see the Air Gap value anywhere just by mousing over or by using your finger on a mobile device. It's very easy to go in here and look at the different value wherever you want to.

You can also change the viewing direction. So depending fewer coming downstream is handy to be downstream from your viewing perspective. It will show you the longitude and latitude ordinate for wherever you're at. If you put in your vessel height what kind of clearance you need it will automatically show that with the color go and no-go indicators so you know where you can and cannot pass under this bridge. This works for all the different bridging and the nonnavigable ones.

So we sent out an interactive demo for this and a white paper, to various pilots stakeholders in the Mississippi area. And we kind of wanted to gather feedback, general suggestions and we pose some pretty specific questions in there.

What we learned is the biggest concern is simplicity. They said we should probably preserve static diagrams with less technological Mariners that were out there. So we did for that as we added the ability to have multiple indicators on their. So we have them at the low steel point, the edges of the navigational channel and at the center. So that automatically disappear as soon as you start interacting with it and if you stop interacting with those will pop back up. We also added the symmetry profile for reference. So those of hearing the pilot cars, appear on some of the ports diagrams but not on others. And pilots generally found that would be helpful to have that included. So this can automatically get generated out of your resolution out of your bathymetry that you have out of your process creating your data.

And also said that there was a lot of confusion about the

indicators on the ports website. So one thing that was very confusing was that we had blue dot on their for the sensor location. What we are actually reporting Air Gap at the reference point. And so it doesn't really make sense to show where the actual sensors are located.

And then we also moved the colored indicators around to match for the lights were physically present on the bridge. And you could also add navigation channel markers but those are better represented down on the water surface. Overall Mariners so that they wanted to reduce any ambiguity and make sure it was very standardized and consistence across all the different presentations that were found on the website.

Another concern was still data. So when you start embedding your values into an image and you are serving data. That can become cached if you lose your network connection and you may not be aware that you are looking at old data. So are interfaces allJohn did a medically and everything is on-demand and so that is not much of a problem and we also provide data freshness indicators we warn you of the date is getting older out of date.

Another concern that came up was bridges can say, so it is really a problem with suspension bridges mostly. It is not a problem with the ones that we have down on the Mississippi River. What is great about having the Air Gap sensors on these bridges as if that you have it in the center of the span it will capture all of that sag data. And even if you don't have it near the edges. It will kind of just have a false negative. So you will report a little bit less Air Gap than there actually is.

Again it is a slight issue but the Air Gap issue overcomes if you are using a standard water gauge. It is very flushable interface we can link multiple which is together here. We just through a bunch of them together to can put it in your ships vessel height requirement. And then he will get a dashboard that shows you going up and down from New Orleans to Baton Rouge and what bridges you could pass under.

This works for any other obstacles that our overhead as well. So there was some heels that came in asking how do we calculate Air Gap clearance for the set of power lines? You know the official number said to take this and subtract this, River gauge which partly did not exist anymore. And

then there was kind of reluctance among different parties to publish to a new official, it's going to be this number - this River gauge. If you put a Air Gap sensor something you don't have to actually tie it to an actual River gauge. So we took the power lines out of the lidar data and then we were able to figure out how to interpolate a water level from nearby water sensors. But we were able to incorporate some sort of Air Gap's we would have to do that.

And also looking how we can present Air Gap data over time. So the ports website currently shows you the last 18 hours of Air Gap data but it doesn't have to have any forecasting future Air Gap data. And we know that we can forecast low water levels since the end of yes is already doing that it just a question of how we do that and bring into visualization.

And also future applications of this we can take and draw us into the virtual, sorry in the augmented reality interfaces as well.

So in summary, ships are already using 90% of the Air Gap's. In the Air Gap's there is that is of able and identified the short comings and the latest data is provided on ports website. And pilots are really looking for more information. As we do measured how we can use the existing data that NOAA has collected to provide high detailed Air Gap values that are easy to update and regular basis. So really what to we need? Well first is outfitting all of the bridges on the Mississippi and elsewhere with Air Gap sensors.

From our experience is much easier to create these visualizations and have confidence in their accuracy when you have an Air Gap sensor versus when you have to use water levels from a sensors that maybe a few dozen miles upstream and interrelate from there. It would help if we are using water gauge scissors to have more them and more critical navigation point. The more sensors that you can put out there on these bridges, the better data that we will be getting in a more accurate data products that we can get out there for the navigators and the pilots on the river. So with that I will take your questions.>> But I wanted to make sure that he was linked to you before I would like to say thank you Thomas Butkiewicz of the University of New Hampshire, since I believe that, Larry I apologize. But I wanted to make sure that he came down and the HSRP members will see the inclusion of that lidar data into Air

Gap and the interactive, I believe we will take questions, a couple of questions now. Gary?

>> Where can I get the Q GIS--?'s

>>DR.THOMAS BUTKIEWICZ: Just sent me an e-mail and we will send you version. Is not there yet but we will give you a version.

>> SEAN DUFFY: Julie?

>>JULIE THOMAS: I am like the worst. Have you done this in other Air Gap ports, the other ports that have Air Gaps or is this like your prototype here?

>>DR.THOMAS BUTKIEWICZ: We have done it on every bridge up the Mississippi up to Baton Rouge and I think every power line that was going over it but we haven't done any areas outside of the Mississippi yet.

>>JULIETHOMAS: All right thank you.

>> SEAN DUFFY: I would like to add one quick point on the power line, so one of the common vessel operators or chemical tanker company called about the particular power line and you know what he said to us is like we go under and the color of course invisible infrastructure. We go under a bridge would like to have five feet of clearance. But only go under a power line 115 feet of clearance.

>> How do you get this information to the mariner on the bridge? So are you, is there a captain at the port order? Is there instruction to the agents that for the vessel arrives, this information is relayed to them, how to access it? And all of that? Or is left to the trade associations?

>> SEAN DUFFY: I would say what you saw today really has not been implemented live yet. Eventually our hope is that it would be available through the lower Mississippi port system. And that the trade associations would direct traffic there. But I would say it is an experimental, but you know, was very well received by the pilots on the river.

I think we have a way to go before we really are able to implement it.

>> If you are giving it to the pilots you need to offer it to the vessels as well. You can put a caveat that it is on the extermination, it is a data model. If you are giving it to the bridge of the ship and the pilot is there got the rest of the land navigation team should also have access to it.

>> SEAN DUFFY: Everybody will have it because it is directly accessible on the web to anybody. Well, but the reason, you don't know this, it's not available yet.

>> **BENJAMIN EVANS:** Correct me if I'm wrong but I think what you're getting at is we frequently see on the bridges of ships with the pilot and master and navigation team. That they are not always working from the same information and that leads to miscommunication and can in some cases lead to accidents where the maiden unwatched technically has reached possibly for the safe conduct of that vessel. Doesn't have the same information as the pilot is looking at, trust the pilot, and vice versa. And that can lead to miscommunication and mistakes.

>> Yes, legally, the pilot is an advisor to the master on the vessel and it is the Masters or the bridge team who make that decision. So the bridge team may put the engines on full start even if the pilot doesn't say so. Because legal liability and every consequence. If anything goes wrong is on the bridge team and not the pilot.

>> **BENJAMIN EVANS:** To facilitate good communication between the master and pilot and the bridge team to the pilot that information has to be available. They need to have a common operational picture. That everybody's working from.

>> **SEAN DUFFY:** With that I will stop questions and we will move on but we have a lot to talk about. I'm sorry, we have very quick panel so I'm going to do a little bit of a job hopefully introducing Heidi Mehl from the nature Conservancy. And this is about an effort to relating to increasing sensors on the Mississippi the day come out of the-- centers [mic cut out]. And the nature Conservancy and groups engaged in this including NOAA. This is really fascinating presentation you're about to see. Thank you.

>> **DR. HEIDI MEHL:** Thank you Sean and thank you all for having me here today I'm really excited to be talking to you about this effort. This is a nature Conservancy of the effort, like Sean mentioned with a number of really crucial partners. To create a comprehensive Sentinel monitoring system for the Mississippi River basin.

So if you're not familiar with the nature Conservancy, our mission is to conserve the lands and waters on which all life depends. We are a global nonprofit we are the largest will conservation nonprofit in the world. We work in 72 countries around the world. We are protected over 120 million acres of land and thousands of river miles.

And a don't usually use a Pernod's I'm doing it today to

make try keep on track. Exxon said it is a quick panel [Laughter] so we are all familiar with wrist to the basin things like with increased frequency and intensity of weather and climate extremes, and faxed to infrastructure and committees. Health hazard to people from fertilizer runoff. And invasive species, let's of coastal but we are having a number that are working to address these issues. We asked at a meeting in St. Louis, we asked whether the current monitoring system in the Mississippi River basin is adequate to determine the level of risk and effects of actions to mitigate those risks?

In other words we are taking all of these interventions stops, are we achieving what we think we are cheating? Can we tell that from the data? So in the spring of 202 -- we are getting together a group of experts to ask these questions and the experts said no we cannot answer this question. We know that we do have some highly effective monitoring the basin and that the nation already spends a considerable amount measuring a number of things include water levels and quality within the Mississippi River basin however we learned that data collection is often hampered by number one, and consistent and insufficient funding. We all know the problem of sensors being taken off-line. And creating gaps in the data set. And number two, data collected using different techniques or using different geographical reference systems. So there is a problem with because as the funding and data collection.

So this slide shows that the coalition that we started building to answer the question you know what would it take to create the Sentinel monitoring system so that we can have better consistency in our data collection? We have grown to include over 50 active members, representing federal and state agencies Mississippi River basin usual partnership, nonprofit organizations and universities. And you can see we have completed the design and costing process and moving into the advocacy funding phase. And noting the nature Conservancy and Corps of Engineers and other important partners.

So through the survey we ask the broader coalition what are the most important issues and what does the system need to address? And these are the four answers that the coalition gave us. Water quality and hypoxia, a navigation safety, flood risk management and resilience and

ecosystems and habitat quality. Through the design phase so far we have focused on the three parties that are outlined in the dark blue color. Water quality and hypoxia, flood risk management and resilience and navigation safety and use those for the technical design. During the design phase we did probe the ecosystems and habitat quality piece and determine this is a really big category and it really needs its own design process and timeline. So that is work that we will be doing in the future.

It's also important to note that this effort is about building on and leveraging monitoring systems that are already in place and getting new additional funding to the agencies that are doing the monitoring. So this is not a fully new effort.

So, these are technical design elements and we brought together key partners to design the system and determine what these elements should be. And we did this by affirming the important components of design. The principal elements, principles elements and data that the system would need to collect and transmit to be accessible and informative and effective to the widest range of users possible.

. I'm not going to spend a lot of time on the slide. But this shows you the three objectives that the coalition determines needed to be addressed and by the Sentinel monitoring system. I will go through these in detail on a subsequent slide. Here is our design at a glance and what I will point out here is the important federal partners that are administering the monitors that are part of the system. So the US geological survey, US Army Corps of Engineers and NOAA.

Okay so objective one, waterflow quality and sediment. So USGS led the design of objective one and the team decided that we should have gauges located at every 5% contribution to the total load for flow, nutrients and sediment. So that is the trying was that you see on the map. Those represent the 5% accumulation points.

We found that to do this we mostly needed to upgrade existing stations and needed only three new gauging sites. Currently USGS receives approximately 2.5 million for existing gauges and operations maintenance. The new system including upgrades and new stations would cost 7.5 million in a 25-year total cost 313 million.

Objective to part one, flood risk management and resilience. So this is led by the Corps of Engineers and the National Weather Service. And they identified 1414 gauges that were critical and needed to stay online. So these are the existing gauges that they determined were very important to continue to receive funding. We can't have gaps in those over 1400 gauges.

So the corps does expect to continue to receive funding for these gauges. These are for flood risk management and forecasting. While these are funded there might be additional cost associated to cover work by the corp of engineers data managers to make their data available through an integrated data interface. So that's included in the cost of this proposal.

Objective 2.2, navigational safety. So while many of the discharge gauges on the previous slide are used for navigation safety. This is where we try to

--we made a total of eight new Cold War systems, three new NOAA Air Gap systems in addition to three existing. And six new water current meters. These new systems will cost 2.4 million in year 1 and 2.6 million to operate over 25 years.

And finally objective three our team felt that it is not enough to just collect the data. Those data need to be usable and freely accessible. So we design and cost today for Mark for creating a publicly accessible data interface for the Sentinel monitoring system.

We envision a place for multiple users to access the information necessary for them. Slow technical design group worked with the USGS wetlands and aquatic research centers advanced applications team to frame and cost the data system.

So you can see the start up cost here, 7.4 million. Periodic update cost 4 million every 6 to seven years. And total 25- year cost is 117 million. For the data interface piece

This is our estimated cost at a glance through our analysis we found that to maintain the current monitoring system for one year, the cost \$20 million. To build the Sentinel system it will take an initial investment of \$23 million. We also found that the total cost to build and operate the Sentinel system over 25 years is 1.1 million. However yes taxpayers will already pay about 774 million in inflation- adjusted cost to operate the current system for 25 years. So

that means that the U.S. will only need to invest in another 3

and 56 million or 32% more than will already be spent over 25 years in order to create this integrated monitoring system that can meet the needs of the future.

So, what we need now, we need funding to build a system. Funding to maintain the system over 25 years, and we are attempting to make that funding as secure and predictable as possible. We don't want it to be subject to removal in any given year.

And accountable process to ensure that the funds allocated go to the-- the funds allocated to the Sentinel system go to the priority needs. So where does the nature Conservancy coming on this? We and our partners are currently engaging with the internal and external audiences to advocate for the spending.

So I will leave you with a few thoughts on the system, first this is not a government's effort. This is not an attempt to move allocated funds around. This is an effort to grow funding for our federal partners. So that we can better protect our communities, clean up our river and help keep the river safe and a reliable transportation network.

So again we want consistency and funding, consistency in the data collection and TMC and our partners can help get this funded through our government relations efforts.

I will take any questions.

>> SEAN DUFFY: Thank you Heidi. I will add a quick, the Big River coalition is looking at the funding request and this information just becoming available. And I also realize we focus a little bit on the Mississippi River today.

I appreciate that. And I don't know how it happened but--.

>> [Laughter]

>> SEAN DUFFY: We have been a little salty dollar. So with that being said, we have time for I will say to questions so that we can move along to the next panel if that is acceptable?

>> DR. HEIDI MEHL: I will add weekly that I did bring printed versions of the report as well as summaries and the report there I'm happy to share that over email. So that you can link to the digital version of the report. Spee 20 yes, Director Blackwell.>> SEAN DUFFY: Yes, Director Blackwell.

>> JULIANA BLACKWELL: So formal. A question related to you Heidi for the sensors and plan for this. The discussion here about you know making sure that things are positioned accurately and up-to-date national data. And I

don't know you did, I didn't hear anything about it, but can you respond to whether or not there is a plan for how these sensors would be positioned accurately to the national spatial reference system to put it baldly? [Laughter].

>> DR. HEIDI MEHL: I'm not sure I could see to that, Sean, could you?

>> SEAN DUFFY: I'm not going to speak to try to answer the question and I will say the focus was on the agencies adding or installing new sensors and that connection to proper datum adjustment is something that has to be figured out.

But we were comfortable because all the government agencies were engaged in different ways. But of course there is more questions to be asked. And okay. Yes ma'am, correct me please.

>>

>> I was going to say don't assume anything, as we think about sensors and positioning it is really good to have the positioning the latitude and longitude of an height and that would be directly related to the national spatial reference system. Another is some things with the chart and the power lines in another those are smart people trying to figure all of that out. I just want to make the point that as we talk about bringing new things online, it is really important to make sure that they are connected accurately to the current version of the national spatial reference system.

>>DR.HEIDI MEHL: I will take that back to my team, thank you.

>> SEAN DUFFY: Any questions? All right. Andy?

>> ANDY: Just to make a comment regarding -- remarks. The system that Tom described as part of the research effort at geo hydrographic center and not intended to be a system at this point. In the district into palace and the information gathering and feedback part and how to proceed with the development of project. And then anything that will go out as an operational system we would envision it going through the ports system so this is a development designed to offer some ideas about what might be possible. And desirable, thank you.

>> SEAN DUFFY: That is a good point Andy. And I will just say that like what happens right now on the Mississippi River is a pilot reaches out to the vessel through his agent. Get a request and airdropped, depending on where they are

going to see what bridges. And then when the pilot goes aboard he presents a pilot card that has different information than either is listed on the no air gaps or on the corp heights. Based on real-time experience. But there is a lot to this discussion, it was neat to see the interactive capability of the lidar, to see that put in practice. And maybe one day that will be available online.

>> Yes just to follow-up on that we design the interactive widget is essentially one on one replacement for the static diagram that is on ports. But to get to your question about how do we get that to the vessel? Because it is delivered as a web app location you can take a \$50 android tablet and pointed to the website that we set up and it will show you that dashboard of all the bridges on the Mississippi. She would just enter your vessels height and then nothing will live somewhere on the bridge.

>> **SEAN DUFFY:** All right I know we are out of time and we have the next panel, and for the hydrographic and topographic data quality and accuracy panel. Speakers come on out. A round of applause for panel, thank you.

>> [Applause]

[Hydrographic and Topographic Data Quality and Accuracy]

>>

>> Okay we will get underway, we are bit pressed for time and we will start. This session, a kind of came back I thank you have heard me talk about data and there was a project we worked on about four years ago and it's like the data was, where does ago and how does it get to the end and how does it get to the products? And it was funded by with an autonomous system. Or wasn't autonomous -- system and we delivered and it know where to put and went to the external source data and went back to NCEI. It is still not public. So that is something we really wanted to address about how do we get stuff through the pipeline and where it's going? There has been a rapid development of technology and we have seen is now that we are in this phase of how we got how are we addressing that? And are such an explosion of data that we all know about. The kind of presents these challenges. But it really is opportunity as well. I think what we see with the National Bathymetric Source and other issues to allow this modeling. As part of that opportunity and grasping that and how we change our

delivery of products and services is obviously an opportunity. Also this whole HSRP foundation has been the same of the foundational data. Is mostly about bathymetry in this session. It is good to see a focus, we have seen lots about the nights new system and ships but we don't talk about what happens after that how you get those products and services that has been great for the session.

The panel we are basically wanting to see where we are with NOAA right now and the data. And also NCEI and move on to some of the users. Never really got to what the uses are in the details of those so I think we have speakers that are going to speak to that as well. Breanna.

>> **BRIANA HILLSTROM:** We are running for a long time. So I just wanted to make the points that so Katrina is going to talk about the national -- the navigation layer in the chart of the future. But we put this group together, we met in advance and a lot of people said I'm not really sure why I am here. Everybody here has bathymetry and have us these pictures of slides right? So why isn't it just digital twin just exist with all this data? So this is really about what is under the hood? Why do we put this together? And really the quality metrics. So that was I think my introduction to this.

I'm excited about it because this is the good stuff.

>> **KATRINA WYLLIE:** Okay. Fantastic. I'm going to press the green button. Oops sorry have to stop pressing the green button. Now I can press the green button, sorry. Okay fantastic. I will start at the strategic plan that just came out. We had this need a driven evolution going on. And I want to highlight two of the goals one of them is to support data- driven decision-making with this data and also involve our systems and processes with the survey so that our success is more defined by timeliness and throughput. There we go so this is all I think of our data-driven evolution. We used to get a trickle of data and just be handled manually, what on a time, the hose, turn on and then there is a lot. We really want to get to the point where we have these systems and processes in place where we can just touch them up every now and then and things just run smoothly.

Why do we have this big firehose that has been turned on and not going to turn off right? It just going to keep going. And it really goes to the definition of what external source data is. So is quick context. We have internal source data and external source data, internal being the -- systems level.

And the hydrographic level, we use it, we want all of the data, we want all ocean mapping data, we will put on the chart that we wanted with the right kind of data. We want to make sure that we have sufficient metadata is present to enable a quality assessment. The metadata, so anytime you go to the bathymetry, you want to have the Hydrography, how deep is it, the quality and who collected it the metadata, quality metrics for the coverage, uncertainty and feature detection. They can be automated. So we had a lot

of internal and external sources coming into the MVS, the ones at the top are oval and Metro internal and external in the Army Corps of Engineers we heard with -- talk. We are pulling the data in. But everything listed to below are resources that we don't have union. There is no external sources and that have a lot of data and a lot of repeatability that we still need to ingest. This is Corned, satellite, close source imagery and the things we have been hearing about the last two days.

Why is this hard? So we asked through the state why is this? Why don't we just have this like done? One of the challenges is like really cultural change. You know we used to do this trickle of data and handle it the more manual way. And so for the hydrographic surveys division. In the middle of the bottom they were dealing with 100, 200 surveys a year. And the other number on the bottom right is from the Army Corps of Engineers lecture that's were the things you posted. So we are going in orders of magnitude of more data coming in. So this really puts an emphasis on automation and timeliness getting out processes in the place. In order to do that you need formats, standard formats and unique standard metadata. You up to have enough information to get those quality metrics. One of the big things that is missing is a standard open point format.

XYZ is not going to cut it. We need understandable format like LES, the has additional information to hydrographic surveys that we can store uncertainty in it.

And also the standard metadata, the streamlining and external source data leaves are working hard on defining what the minimum metadata is. With all these new external sources, that might change based on all the different streams of data coming in.

And so the number that kind of culture change in the number of surveys, datum, your NOAA about datum's. We

need to be speaking in a common language. So we need to know what version of --collected that data in. We need to have a coverage transformation, a cover full of transe ranges and those uncertainties available. And one of the biggest challenges are local datum's. You know, not everything is to be lower water. There is a lot of datum's out there. And so-and-so is like yeah, I reference this point for ten years ago. And so understanding what the data was collected and so that we can do the transformation and focus on that navigational part. It's great that the national is being standard but we need that chart data. We need to have the navigational data as well. And is critical for navigation. Because we don't want to--

>> I will pause you for a second. Can you slow down for our interpreters and our Captioners please?

>> **KATRINA WYLLIE:** Yes I'm sorry I have so many things and I don't want to run out of time. I will so now. Okay uncertainty. So long the lines of this culture of change his paradigm shift from internal source to external source. Our experts in the hydrographic survey review of very good at knowing when there centers are and what the test was and all those details to get a total propagated certainty model.

But when you start taking new sources of surveys, you might not have all of the information. You might need to approach uncertainty in a different way. And so understanding uncertainty is critical. For this metadata. In our ability to add it into our compilation.

Everything has an error budget, right? We want to know the measurement and the confidence of element of that measurement. Is that slow enough I will try to go slower. We presented on the national bathymetric sources in the past but we are but of all rhythms, we collect data and normalize the data and normalize it with hydrographic data and then make bathymetric products. So we are really you know, we believe in transparent and automation and taking the human and using them for what they are good at and letting the computer do the rest. If the ESD, and external source data coming in is right that great and if it is also in the firehose is figured out and all the metadata is in there, and has uncertainty in the datum's, it is actually still hard.

There is still challenges and really that deep in the ability, it changes, it doesn't stay the same. Thank you. The slides came up. And so the best bathymetry is not always the most

recent bathymetry. But that is really important with all this external source data. When you have an external location you might want the newest data. But when you have different data streams with different qualities, again, we need to understand how that bathymetry changes in time and space. And then the throughput, throughput matters. That is the successful going forward in the strategic plan.

We need to be able to build this but also to be able to maintain it. So you see Boston, scraping and updating the products weekly in the southeast and in the Gulf checking and monthly but really we get to the point of the Mississippi River where we need to do this daily. So you have to have everything in place so that we can get the data from the Army Corps of Engineers every day and get these products out. So that is a challenge. We need to make sure that we have the infrastructure in place in order to do it. So that is the bathymetry.

We have our pipeline so we are supporting navigation. We are supporting our internal project planners and then public because data has to be accessible and we make that accessible with a blue topo which is on the national modeling and then international modeling. So blue topo is available on a WS and also in the now coast which is the web app --service as well.

And you saw the opening data and images I think from -- and Alan's presentation we want this to be excess will for all the users. So using open formats, geoTIFF with the tables and also the grid, version two and the version 2.0. And third layer of contributor so that metadata is used for combine and the MVS but it is ability products for downstream peace. So that metadata comes in as a third layer.

Just to summarize, metadata is important, NOAA makes bathymetry and without that metadata it is hard. So we need that to inform our compilation and downstream product use and whatever the filtering ends up being, the bathymetry is foundational to that. So thank you.

>> **BRIAN MEYER:** I'm very happy to follow that because she gave my presentation for me. My name is Brian Meyer I work for the national centers for environmental information and I will talk about all things bathymetry at NCEI from receiving it to archiving it to distribution.

So the NCEI is responsible for hosting with the largest of the archives of atmospheric, coastal, geophysical and

oceanic the anaerobic we like to say that we host from the bottom of the ocean to the surface of the sun, everything in between. And that is where nations leading authority for governmental information and one of the front facing people at NOAA for our user community. So yes.

So what do we stewards as far as the bathymetric data? We have data coming in from every possible corner of the world. Public, academic, government, industry, within NOAA and outside of NOAA. As you can see we are hosting petabytes of data, we have gone beyond terrible rights. And that is just-[Laughter] and these data as our growing exponentially. You can see the differently resolve the bathymetry that we host between multibeam single beam, you know, lidar, crowd source with [Muffled sound] pushing all during this panel. And things that we haven't even seen yet by satellite derived bathymetry and things we just can't even imagine.

So how does the data get here? We have been stewarding bathymetry since day one of NOAA or since before NOAA and since the office of geodetic survey by Thomas Jefferson, we have records going back that far. We survived every single technological data transformation and we will survive this one as well. [Laughter] from paper records, punch guides and most of the data these days is coming through FTP, WAFs, and hard drives, the bandwidth of the UPS is much greater than and with of Comcast or whatever your Internet provider is. So you know and we received these data from countless numbers of providers in every single possible flavor. And format and data organizational structure. And all of those different data types that was talking about have their own data management stovepipes. So but they all follow essentially the same structure, data sent to us and we reorganize it into the data structure that is well-known. The harvest metadata, populate databases, cruise instrument, geometry and what was just talk about. [Connection] and that is and if it is not safe and then we publish it to map viewers so that users can access this. NCEI

--File by file, package by hand or delivered from tape or spinning disc. And so what we are doing at NCEI is we are experimenting with various ways to display the data so that people can find what data is out there. And find what data is most relevant to that. It makes no sense for someone to download every bit of data when the only just need for you

know specific port or a transit or whatever, you know area of interest that they have. And so, one of the things we are really going to be leveraging is the cloud. Which is, going to fix all of our problems I have been told. [Laughter] but when we moved to the cloud of this is an opportunity for us to really work together with the global community to make sure that we are moving in the same direction towards interoperability. And accessibility and all of those fair principles that we all rely on here. So, there is definitely a tsunami of data coming. And we are already, it is already hit but there is not just one wave, it is going to be wave after wave as more and more observing platforms come on board. And accrued systems and increased data density from advanced systems and things like that. So we have to get ahead of this and so we have to morph these stovepipes into something cohesive and one NCEI cloud interoperable system. And the cloud will actually help solve this issue and the dream is that both the providers send the data to us and the cloud so that they only have to touch it once. And then we don't have to touch it all. We can just bring it to them. And that we don't have to send the user's data. They don't have to download things. And they can just build their products in the cloud. And digital twin and all of that. We should not have to be moving as much data as we are.

Because every time you move data, it becomes at risk of being corrupted or lost or anything like that. So if we are going to use it many times and we are going to have to move it many times then you start to lose quality and you start to lose information. So get to the point, we need metadata. Because the more metadata that you have, the longer the usefulness of that data will be. This is one of our paper records. This is bathymetry. [Laughter] and in 75 years the data that we get today could potentially be this incomprehensible. Because if we don't have the metadata. So what NCEI has done as we have developed a tool called CruisePack that will help data providers provide the correct metadata and package the data in the correct format so that we can increase the throughput and we don't have to spend so much time wrangling the data making sure it has everything we need and it saves us time on the packaging and as well. So that, so just really want to emphasize the incredible need for a greater emphasis on metadata and data management going forward. And think of something

that can balance it, we need an additional dedication to the data management.

Because the data management paradigms in the cloud and digital twin are changing. So we need actual funds, focus and location to the data management going forward. Thank you.

>> [Applause]

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>> **WILLIAM GAVIN:** Moving along I'm William Gavin with the Corps of Engineers I want to express my gratitude to be here this is my first time to present to you all as a group. I have been a project manager since a little after its conception. Sorry. With, I the project manager since roughly 2014, started as a grassroots effort. From around 2010 with the Portland district around our organization. And today I want to emphasize the role that the standards and data sharing play within the world of navigation products and Data services overall. Expressing the anhydrous country into the field. Most notably, the data sets that the eHydro produces where we are listening to today's conversation and trying to remember all of the key points that I did not include in my presentation. Were eight minutes is not

enough to tell you all of the details of what eHydro does and how we piece it together. What gets us to the total number of 92,000 surveys, that date although way back to 1985 on our side within our data store and I will touch upon some of the other organizational components.

But as we go through I do want to emphasize what Bree has pointed out, what Katrina has talked about and what Mr. Myers is expressing with metadata. The components of data sharing. And documenting all of the information. And how eHydro is using standards, data stewardship and I want to echo Mr. Myers sentiment there at the end of his presentation about the data management concerns and us as an agency as well. Being pushed into the cloud and just the same where the cloud is supposed to save us all. And it is a huge challenge to incorporate this technological advancements. And as you can see I want to also express to or at least highlight 2 components of what eHydro's missions are. And improvements we want to work towards. So overall, also that was mentioned for what eHydro does, we have over the years considered what is the least common denominator of data and that is the down XYZ file.

It is not really sufficient for all of the additional components worth of information and data that needs to be combined with the bathymetric surveys. What eHydro does is standardizes a common set of geospatial data products. The cover sheet files, QMLs, geo-databases, were all of this is automated within the court across all of our districts.

Our districts are organized by division, we have eight divisions across the corps seven of which are CONUS and then OCONUS are we are broken up into 38 districts and that each district operates autonomously for the purpose of navigation mission. One of the data since I didn't mention and trying to remember here, while order mission does focus on keeping our channels open for navigation and for safety purposes. We are also engaged in the sediment transport effort. So now there is a new framework of the geospatial data being referred to as the national sediment framework. To complement the national frame work that is under the eHydro and that is how these are all tying together. Tying together through the channel management and now by extension this new foundational layer of the sediment management framework.

And that includes the placement areas and the borough areas which has recently and our New England division help support Boem in the data collection effort as well as data collaboration for the data discovery for their management and decision-making as well. And so we have now created an national data set for the sediment management. To complement channel framework. All of which are supported by hydrographic surveying.

Through the stewardship, through the standards, the two main components that due to time I will only scratch the surface that there is an ongoing effort that is intended to be completed next calendar year. Where myself and several other coworkers have formed a working committee of sorts. To create a national USA wide metadata standard and is utilizing the ISO 19115 format. Through this we are working through Katrina's efforts. So we can assess the -- effort in being able to provide all of those details that was in Katrina's slide. There is other components of without the metadata particularly focusing on the data itself. The quality and including the creative-- licensing and we are working with the Creative Commons as well so that we can have as the agency all of our surveys licensed appropriately so that the

other folks know how far they can use this. And I'm trying to make sure that I don't miss too many of the points here.

Noting that I am not-- I am out of sync with my slides. I just want to refer to the fact that based on stewardship and standardization, eHydro at the district level, noting that there are 36 navigation mission districts. So as I mentioned earlier there are 38 total districts that are CONUS are and only 36 of them have the navigation mission. And only ten of them have the mostly operate autonomously. And they serve their local customers. And so eHydro is having to struggle with making maps for dredging purposes and utilizing a wealth of technology, trying to standardize and format that any package can then be served out as another foundational layer. And a part of that is taking a vantage of the spatial data standards for the visibility's instrument. So the SS ID for our side of being able to have that data put into a standardized format that can be shared and that is publicly available and can be extended for machine readability. And so the high-level document that is on the screen is referring to how each district on the left side incorporates all of these different data sources, ran through a series of Python utilizing-- mass and have it run through additional automation so that we can publish it. Over the web. And then have that available for public consumption.

And part of the communication tools that we need is an online up-to-date catalog that shows how our districts are managing their data sets. And that is something that we have been working on quietly in the background that I am kind of, letting the cat out of the bag for Katrina the moment to say we are wanting to engage and I will run now because I'm running out of time for the improvements here. Me to be able to engage with OCS. And I will speak just a moment to the two different products. That through this catalog it allows being that it is utilizing JSON technology it shows all of our data sets. All of the surveys and how districts are curating the information. Through the eHydro system. And then very quickly, noting that speak to the postcard to much, but the eHydro system is providing information to the IEC program or the inland waterways where they are able to programmatically build a project

depth contour line as an S 57 overlay. And programmatically give that to the Coast Guard vessels so we can follow the track line on their -- machine and more effectively place

buoys and keep the channel placed on the inland system. That a significant reduction of fuel cost was significant increase in productivity. Because the vessels are no longer having to scan with essentially their basic depth finder to determine where the contour depth is. The canal pretty much a drive right up on and drop the buoy.

Two minutes over. There is plenty more to discuss. Again thank you for having me here. And just wanting to emphasize in short what all of my previous presenters have pointed out, metadata is a big thing to us, we are implanting standards as best as we can. It is a cultural issue within our own organization that we are struggling with. And so through standardization, data stewardship and using all of our existing technology, automation we are trying to get all of that into the cloud. So as a data provider we can continue to give you this foundational areas that we are responsible for. Thank you.

>> [Applause]

>> Okay I will try to present quickly for two people here, Shannon Hoy is battling the seas of Alaska and also the mapping lead and then Vicki Ferinni.

I was involved in the expiration for a while to we might be in sync but she might be allowed to say. You are gathering a lot of data that will be used by others and then unknown use we talk about survey once, many times and we don't always know who those users are. The differences in for them and many of the other scientific and exploration users like many have the users right next to them and there is the scientist, psychologist, geologist that are sitting right next to you when you map that data. And we are planning the RIBA dive the next day. So that use, I think the unique position to understand how that works and what you need to do to your data to get it through. So in doing the mapping for the exploration it is trying to establish you know maximizing the coverage and get the best data that you can. And that is where there are not many sinners and it's time that we get some I think to get that metadata through the standards and then is visible and then you can use the automation to get that through and produce those useful products so it's really important to do that. The other thing is make sure that it is accessible quickly.

So the objective there, it is trying to make this effectively useful for the stakeholders. And I think it is one of the issues

when we talk about it, it's like who are the stakeholders and how do we know and how do we find out who they are? And how do we get the best products and services then that is useful for those, for those stakeholders and the future users that which is really important. One of the things the way that the approach from OE from the ocean exploration and others on grants for them. The different levels of data that we have for them. And this is the thing will I think we also talk about data in this giant is a term that we use. But it is really data and products. And some, one person's product is another person's data. And it is then the derivative in the sense that get produced as really difficult. And we see it already. And I will mention this I think Katrina mentioned that GM IT is part of the national that the metric source. We already have the 200 of data of a derivative data in a national bathymetric source. How we manage that properly?

One of the things that is very important for the future use of the data is yes it is processed so for the date of the sensor data is processed. From the ocean exploration point of view. They also produce the process point fall data if you like but in a generic sense of format. So that can be used and for other uses it is not just a product level II data. It is available for use by others. And then is available industry did to make a discoverable ocean explanation site and also NCEI.

From that, the initial tools, sorry from the bathymetry point of view, that is bathymetry, some of the tools to do surface and the backscatter comes important and all of that. And the other thing that is mainly departed, it is just not navigation use. It is not only gathered from the vessel. It is also gathered from AUV's, RUV's and other systems. So we are doing and thousands of meter so doing mapping ten meters off the seabed, so that is really applicable for that data when you're down half meter of resolution and 3000 m of water and how do you control that vertical uncertainty in those kind of things? So is a variety of data, not to scare everybody, you know what the density of data is in shallow water, well it isn't there for the 3000 m of water.

So the future proofing I think that is one of the key things about not knowing really who the stakeholders are. How do you make sure that you have got a path and a process to really store that future data? And water, is one where

people say this is too much data, we will not store that it is too hard to. But you have got to do it. It's part of something the ocean. I talked about that and I think mentioned in the, it's like we are out there, we should store everything that we can.

In the space and management of that we just have to do with it. That's what we have to do. So again, well we would love to meet every objective and that was talked about in the previous panels, it is like, we need to just work on those products, how do we best together what we can to make sure that we are getting enough to future proof and use it in that future? So hopefully this goes to the next presentation. Okay. Jim RT the global multi-resolution topographic data set. This was funded --and it was academic fleet for archiving that data into a suitable infrastructure. And is a elevation data, with imagery is a tiling scheme but also try to make it scalable for QC getting it through that. So that this is unlike I think NCEI, the raw data archiving, this is a bunch of data in that, that is and that that has been QC and I guess why it is used in the national bathymetric source. So the goal was to create that seamless integrated data set.

Making sure it's resource both for the specialist and a nonspecialist scientific users. And who are the stakeholders I think they have a good idea of who they are. And also to continually expand that coverage as they go. Making sure that it is capable and making it efficiently scalable but with a normal data stewardship. It is the tile synthesis, we can go on the details of that. They do have different projections.

The data that goes into that, if it is, you know we will talk about how it is processed. But there is the grids and images but there is also points and then there is other tools that go with that. For people to be able to access and understand the data and make it useful for all of the potential users.

It is a good composer. So various data sets go into it to combine to give the background to the data that is topography and bathymetry, other grids that contributed and already. So that is where I wonder sometimes it's like this grids to support in some places. And are they being reimported to the national bathymetric source if they are already been somewhere else? I think that something we have to address to understand. But the primary one is the multibeam synthesis.

In the way that is being done it you have to go through just

--and the --team would take that source data from the you know SSHA, past the raw data and go rectally through our to our and roughly through NCEI and also process and pass the processed swap NCEI to NCEI. Not sure that Isabella from NCEI so from an accessibility I'm not sure that process data is actually easily accessible. But you can get it on the GMRT site. What has been happening lately they are moving to doing the processing of the data and building those the GMRT on those vessels and this is trying to get the throughput from those ships that deliver straight into the GMRT. That broadens and accelerates the process to the GMRT.

The resolution mostly is that 100 meters and this is right through the whole data set. And it blends the piles from each of those different processes. But then there is a raster for each cruise that is combined into the GMRT data.

Preservation and accessibility. I think this is there if the swap tools point grids and images kind of through that from a specialist kind of tools and knowledge you need through to the, as you go through that. It increases the accessibility through to those nonspecialized tools. And also the people and places that need that data set. You want to be able to have that across the whole spectrum of both the preservation and the accessibility. So I think the conclusion of that is the stewardship again isn't making sure this thing what the future proofing and metadata is vertical to this.

Making sure that we got that swath process data because of others want to use it in other ways that we don't have to start again. And this is where we are supporting the GSF, its focus mainly on the US academic fleet but it goes way beyond that. And again it complements the roles of both NCEI but also now part of the national bathymetric source.

So there is a number of questions for me but I think that is the general, the approach of the GMRT team and how they fit into the broad bathymetry archive picture. Thank you.

>> **LESLIE RUTA:** So I was definitely the one that said why me? When they say customer stakeholder that is me. My name is Leslie Ruta I'm the director of planning at port of Corpus Christi. Port of Corpus Christi is who we are done on the coast of Texas, a little city with 400,000 people, not a lot I get it but happen to be the number three port in the US. Also the number one exporter of crude in this country. So when you're talking the American crude going overseas to

help a country like Ukraine or NGLs that are going to Ukraine to help them that is coming from our port in Corpus Christi.

We are a landlord port so we don't do operations. A lot of times when you think about report your thing about containers. We saw pictures of containers earlier today. I have O containers that move through my port.

Again landlord, so we are hiring out all of our operations. But most of my docs are liquid docs. We are also governed by seven commission at Local 7 commissioners. They are appointed by the bodies that one city and two counties that lie around our port rate their corpus. San Patricio, has one, Corpus Christi has three as well. And what do we do? Your hearing what goes into this. Our main job at the port of Corpus Christi is to keep that channel open, to ensure that commerce is moving through our port.

I can of skipped ahead their. One of the other things about our port is that all of the fees, so every dime that comes into the port is not taxed. We have the authority to tax and we have never exercised that in 100 years. All of the fees are paid by our users or customers. More phage, dockage and land leases is how we are finding all of our infrastructure projects and technology it bounced men's. I went through some of those. And I should've started earlier. If I'm going to say the word, OIL, I am a true cell Texas kind of girl. Just to say when I say "oil" I could say the other way but it sounds just to be. When I say that you know and talk about oil.

When removing crude oil, it came out right that time, awesome. You get into the weird statistics that we are not just the number one mover for crude oil in the tech and USB are number three in the world. So suddenly making sure that that channel is open is really, really important to the United States. As well as our partners around the country. The way that we are doing that is through customers. And our customers rely on us, not to just keep that channel open. But my friend Mr. Gavin here talked about judging, making sure that it is dredged through the appropriate depth when you're talking about moving 100 got moving a million barrels of oil I want tinker. It is extremely important to know where that thinker is an old were that Tinker is know mac way to. Ground anywhere.

And to be able to do that you also have to know what is on land, I think Julie mentioned earlier it's not just about the

waterside is also about the landside. So we have to know how much Drudge placement area do we have? We are currently in effect just this week if you look at our news coming out of Corpus Christi, we just let the fourth contract in our channel provement project, I took these slides out, of course I took them out. But we just let the fourth contract to make this port the deepest in the Gulf Coast.

So when you start talking about data and why you would think any of this is important. Yes I'm very concerned about my talent making sure that my channel is open. But this is a flow slide that will show you if it works, where my product is going. My product I also kind of claim it all as my own, my channel, my product, it's all mine. And I'm not the CEO just the director of planning. Where it is moving so moving a product to all allies around the country and even in some other places. When Russia invaded Ukraine this became even more important because a lot of these countries, a lot of our partners around the world suddenly did not want some of that product from other places. They wanted to come from Friendly's and not so not Friendly's.

We also in addition to moving traditional fossil fuels we are moving a lot of other product. The other number three and I believe the number two or number three mover of natural gas. Out of our country. To our allies. We also have some of the, we move a ton, tons [Laughter] of wind components for moving them in, there are several wind farms throughout the country all the way to Canada. The product comes in, those components are coming in through Corpus Christi and moving all the way up through into Canada of crating more wind farms around the country. As an alternative fuel source. We are also in the business of carbon management that in the state of Texas we have exceptional geology that is perfect for sequestering carbon. They have a lease underway to sequester carbon and have to carbon safe place and to grants where we are looking to ensure. So you and your talk about data and land use of that, one of my dreams, dreams but what we are going to do is use the data that we are collecting under those carbon safe grants. Put into a digital twin. And in the-- and very much so we can show the stakeholders and neighbors what is carbon sequestration? Where is that going? When I say plume, what does that mean? Or does it go? So we want to be able to do that as well. Those are customers, when we say that we are

moving all of these products, it is their product that they are moving. So these are some of the customers that are already in the port space. My port space again.

I did not take the channel to vomit out. So \$681 million. Is what it cost us. So when you're talking about \$681 million to deepen that channel. Suddenly all of the bathymetry, all the information that is being collected by my friends here is a stream important. And then moving in to the USA a space will return about Drudge placement, no that we are at this depth we can maintain the step and all of those customers, about half of our docs are private docs, half of them are public docs. I'm response will for ensuring that the public docs are Drudge to the appropriate depth, the customers are responsible for their appropriate docs, and how much Drudge you have it available it becomes important when moving we can locate that data in existing two-way. It is very important. And it makes it easier. Here is the channel because of the infrastructure in place because we are moving fossil fuels we are ideally situated to move hydrogen or one of its carriers like an ammonia. And so almost our entire, I think the number is about 90% of our customer pipeline is hydrogen right now. That everyone who is looking to get into the hydrogen business, or the ammonia business is looking in Texas. They are looking at Houston.

They are looking at Corpus Christi. And we do have a bit out for the hydrogen hub right now. Whether we are hydrogen hub with big agents because we have federal funding port or a little ages because we are joining it anyway. Anyway that is the next part that will be flown to report.

Can of skipped, another map, really quick to show you some of that again. So still moving to those same places because the same people who are using American fossil fuels today are going to--

>> I'm sorry can you slow down just a bit?

>> **LESLIE RUTA:** Yes ma'am. It is moving through, is going to be moving through the same countries. And finally, and finally the last thing. So again talking about all of this data and how we are going to be using it. When you talk about really a commercial operation. We are a subdivision in the state of Texas. There are no, there is no stock at the port of Corpus Christi is a state entity. All of our dollars, all of our capital dollars, revenues go right back into the port to create the facilities and products and services for our customers.

To enable commerce. What are we doing in that space? We are creating a digital twin starting in our security space to ensure [Laughter] I was going to say was of the digital twin or security?

>> [Laughter]

>> **LESLIE RUTA:** It will actually I want to be able to present to you and see we can show already but we are not that far down [mic cut out]. And heading up the enterprise and see where all of those assets are. Earlier we talked about how what happens on the water is supported on the land as well. One it takes \$70 million in 2023 to elevate a dock, this is something that we have to plan for. I can't just go out and say let's raise that one today. It is not that quick I think someone mentioned it is 20 years in the making to get something like that done. Ten years in the making when you start saying ten years in the making you are also doubling that cost. We actually go to do the work. So if it is 70 million today, ten years from now, I will need \$140 million to make that plan work. Asset management suddenly becomes very important to be able to predictably

plan for that, save that, make that happen. We also use it in our incident management. That our entire incident management system. Be on the coast on the Gulf of Texas we are faced with Hurricane and about every year and our incident management team uses GIS products and to be able to capture what that damages all across our port space. We managed 30,000 acres of land. So is a pretty big job. We need to have a really efficient way of doing that.

When hurricane Harvey came through, Houston got a lot of splashing news because that poor city was underwater.

We got the wind. When that happened, the port alone had about \$20 million in damage. To be able to capture that damage in technology like geospatial you know when you talk about GIS, it is so invaluable. One Harvey came we did on paper and we vow never to do that again. It was really impossible.

And then from a climate change adaptation. Then the security place with our digital twin we are taking our channel into a digital twin so we can see that and we want to be able to put that in the hands of our pilots. We want to be able to add information to them to be able to do their job better, safer, faster and increase operations. Carbon sequestration we already mentioned and then tracking all

the hydrogen connectivity and connective infrastructure. So those are our wise, we are major mover in the country of American-made products. We are exporter not an importer. And to be able to have a databases and have it a standardization is we are standing up the digital twin. So the future proofing of that it is terrifying opposition right now.

That it is going to be a challenge. But we don't get to standstill. You have to do this right now. Thank you.

>> [Applause]

>> LINDSAY GEE: Sorry we will have questions but you are Julie right?

>> BRIANA HILLSTROM: We are way over time so don't know if you want?

>> LINDSAY GEE: Yes we have one more slide and I think Julie wanted to, as well.

>> JULIE THOMAS: I do but let me just say that the rest of our time today is our internal discussion I think this really interesting if the panel agrees we will just finish on this and finish this up. We have a lot of time tomorrow to discuss and I know Gary we have that that is first and foremost on my mind. So I thank you just go.

>> BRIANA HILLSTROM: So we had commenters this is interesting because all these commenters have did bases of data and they are all doing the same thing. So this is all about how can we use them, how do we intermingle them? So Julie was gracious enough to volunteer to comment on Ellie Long Beach because that has been the model for many years of putting it all together.

>> JULIE THOMAS: It is just one slide. Does this come off? Can I slip this off? Okay. First, is it is interesting, I love the Corpus Christi discussion. So I'm going to talk a little bit about Long Beach which is importing. Crude oil.

Yes, we can get into that is a whole other discussion, export to Asia and we are getting it from Asia. So the reason why I think this is pertinent to this discussion which I love.

Because in Long Beach, when, let's see-- in Long Beach we have been running this under clearance program project for it really went operational 40 years ago but they tested it 3 or four years before that.

So I just wanted to say that we could not do this without standardization, metadata, and I'm very glad coming from the physical oceanography side, waves in particular, because we standardize, we did not get funded through any

federal funding, I mean you can correct me but even the Army Corps of Engineers for our wave release and we had to have standardization in our data because it had to go out to a lot of different agencies including NOAA, NBC so we work with NOAA on standardization but the waves and currents much different than this -- overwhelming to the amount of data that comes through. So the reason why this is kind of pertinent is because all of these products appear as standardize. So these all support the oral company which was Bolero, Marathon, Vandever keeps changing its name, what to call it Marathon. The channel was 69-foot and now it's 76-foot and for every foot of draft up again you probably know the latest, it was about \$2 million per foot. But I haven't looked at the latest crude oil prices. So this is pretty significant if they can gain a foot of draft coming in. But the problem is with a 69-foot panel and figure the 10% under clear parents. We started running this program that are based, they started and they want to water dam, and Long Beach went to water dam, there is a company there called Charta they run a software application called Protide and they have implemented this now they bring in these tankers. Anything, itself is 69-foot draft and the channel is dredged to 70-foot draft. So all of these is the parameter that they decided they needed before they moved the crude oil tanker into the harbor.

Ties at the very top and have far left, we have tides from CO-OPS, next we have the winds what actually not of the oxide the National Weather Service office.

The next one is the MSEC six-hour wave forecasted updates and it goes out every 5 or seven days and it comes out that it is a Wade forecast out of NOAA MSEF the last one is from the bathymetry source got your program there at Katrina.

And on the bottom so those are all fed to Charta as they update their and sent directly there and then on the bottom there is a program at scripts energy oceanography called coastal data information program known as CEDA an very high resolution buoys, around 60 of them around the coastal U.S.. There is three of them at the port of Long Beach. Southwell, North swell, one at the entrance. They are dedicated to the Army Corps of telephone you. A little bit of ICE funding and some Marathon paid. So those buoys the observations are really critical because if you don't know this when the Southwell hits Long Beach, it can close a

channel about 4 or five days a year, 5 to six days a year. And the waves just come right into the channel when the 1200-foot tanker starts to pitch for every degree of pitch as it loses about ten feet of draft. So that is why the waves, of this particular port are really critical for bringing in the tankers.

The next one is a nearshore model that we do, this is very different than NSEPS which is based on satellite winds. The one on the bottom is also produced out of scripts in CEDA and data-driven we have a buoy off of Inception and one off of Point Loma. Into the south and another one-- island to the west. And we really do the transformation of waves to the harbor. We run that one every hour because the pilots needed something updated for the wave model more frequently than the six-hour, 12-hour projections coming out of MCEF. And we run that one hourly and then also out of the hurricane which pass through California. There was too much refraction off the jetty from the west. So the waves were actually heading bigger now and now we ran another one hourly. Which includes the actual buoy, is basically tweaked for the local peewee right there. So is all that data is assimilated and we tweak the model accordingly.

Next, there's the motion sensors on the vessel itself. And first try to have all of the specifications of which ships are coming in we need to know the draft, the girth, every thing about it and+ the actual motion sensor pilots for the Long Beach to actually measure the motion of the vessel.

All of that data is sent to Charta is updates and one through a program called Protide and sent back to Jacobson pilots in Long Beach and basically, I don't have a picture of it but it is a really nice depiction of a vessel that the water level, and what their window of transport can be, so that is in our window, an hour 1/2 after that you know the tides change, the waves might change etc.. So they give their know or know go to the pilots. And it really is a digital twin and watered-down that they are running.

So these data come in from different sources. They are all having a metadata. They are all standardize and the CDF files or whatever standardization for that particular parameter and then it is sent to Rotterdam, and run what I would call now digital twin and send back to the pilots. So that is my real brief presentation. Thank you Bri. For letting me do that. I know I said brief, can I just show a slide two

but you all, it is a big task I know but trying to, Derrick knows how much we were done metadata and standardization. Because we could not do anything. And eHydro because we used to send we data into it.-- on that we back then. That was sometime ago. And it was funny because he talked about then the autonomous you know, each port they could not get them to standardize. So sitting there listening and going Ohno it is still happening. [Laughter] anyway that's what I was when to say.

>> **LESLIE RUTA:** Cannot add one thing that Julie said, a vessel the size that your talk about, it is more than a size issue. If you do length overall, a vessel, a tanker that is 1200 LOA, is carrying 2 million barrels of oil. And they cannot completely load much like an airplane. They are not going to fly or traverse the ocean half will, they will go offshore and do what is called reverse light during. Everyone know what reverse laddering is? You have two vessels out here so it's an environmental issue suddenly where you have extra everything happening and then more potential for an accident. So that one foot of clearance suddenly becomes a very big deal for the environment. Spee five so they were totally lettering everything will time they came into Long Beach and it took three vessels that they do off the tenor banks stuff of San Diego between San Diego and LA. I know they don't want me to publicize this but there has been three people killed in the last 3 or four years. In the process of lightering and you can imagine with the Californians all of the ships lightering all of the time. That was a big appetence that's why we had a lot of support through the port for this project. Thank you very much for the informative aspect and safety.

>> **LINDSAY GEE:** Thank you Julie, any comment further? Thank you.

>> Hello my name is Quentin, the navigation manager for Texas. OCS. I want to highlight having the service of the translator about all this information to the stakeholders. You have the pilots, you have recreational boaters, you have academia, all speaking different piece of data and coming to me and different with different data, different formats and it is all valuable. But in order to be efficient, it needs to be standardize. And we are working with the Army Corps, and is rogatory and that is data and after some of the data after they renovate or add, add a dock that they submit data to

the Army Corps. The data can be electronic, data can be-- it is valuable information but we are try to figure out ways to collect the data and then standardize it and turn it into ESD, that can be formatted and processed. And inefficient manner. So is kind of thinking about the top, the top thing on my plate is customer satisfaction. And then you're going to efficiency, metadata, and the data. You are trying to look at that all at the same time. Because you have information for example if NOAA goes out and surveys as the survey project last year a hurricane comes and then there is deepening and widening, all of the information prior to that in the mind of a pilot or recreational boaters, the archive data is not a top priority is the most recent data being reflected on the ENC charts. From the geographic perspective you have eHydro and even though the channel might be updated it's kind of like imagining having a highway, a highway is updated, but if the exit or entrance ramp is not updated, then the pilot who is coming from abroad is like, we have to go by according to the Coast Guard, we have to go by this. And with Corpus Christi, the Marine-- charter division team I can't thank them enough for the turnaround, something that would take months they turn into a week or weekend a half because of the urgency of having multi million-dollar vessels, super Max to vessels sitting out and waiting, I can't move until this ENC chart is updated. It is just huge. So being able to standardize the data and have a process, Corpus Christi their GIS platform was amazing. You know, something across something that the facilities can look at and the recreational boaters can contribute information as an essential source that can be automated like the -- division when I look at eHydro. It's almost an automated process. What if each of the ports had something similar? They already know how to standardize and format the data and make it submitted to one entity.

And then that process be automated is huge. When it comes to looking at different ports, different sizes. You know Houston, Corpus Christi, Port Arthur, Brownsville, all different recipes, different entities, but if they had some simplify method of collecting data were the facilities are confident. And thing about data when every single second matters when they go out and dread and update some information there like your it is. Here is the information. For how long will it take to update the ENC chart there just like

the recreational voter they are pulling out the raster chart, I probably should say rasting. But pulling out the archive in Turnersville using it because I think is the most reliable thing that they have. Especially when they are all the everyday. They could be an objection that has been moved and there like we know it has been moved in the pilot know what has been moved but is still on the ENC chart so we have to work together to figure out to expedite the transfer of information from standardizing.

It is beyond valuable. Thank you.

>> **LINDSAY GEE:** Thank you. So I think having seen that, I apologize to all of the panel that you speak quickly. I should also apologize to the signers that they also quickly.

But it is something that you see the challenge is and I said is an opportunity but then we talked about two ports and there is many, do we scale this to all of the ports and operate at 355 days a year, one for hours a day, to have the same services of that? And so that is why the metadata and making sure that this infrastructure and foundation is in place. Is just critical. And it is kind of forgotten I think.

Sometimes. So is really good opportunity to have the panel to talk. So questions. Yes you want to say something.

>> Firstly, I want to congratulate Corpus Christi Leslie. So we have been talk about the president a twin and navigation for 1 year 1/2 and we have not been able to convince our friends. So you did it in one shot. So thank you, thank you. I have come hundreds of times to your port and love it, I live a couple of hours away.

Highlighting the geographical challenges that you have especially when the big ships come in. The hydrodynamics of it when it is entering to the bridge and going, that is what we are trained to push in our panel and trying to recommend for NOAA to develop where you can have a real-time digital twin see how it is happening. More important for the future, be able to run the models on it.

Because the digital twin was corrected and correct yourself, machine learning, deep learning and to get there. So I wanted to congratulate you on that.

Quentin, we are all friends, we are all warriors I call it. We been trying to convince the folks on the Houston ship Channel. To buy in for fog sensors and for Air Gap sensors. I believe it was \$27,000 we got the quote but when no one was willing to put it. So the Houston ship Channel is the

number one channel the number one port in the country. It does not have a single sensor. At this time. So when you go to ports, you can check it right now, it doesn't have anything. And we have been trying, we actually work together on a subcommittee. In the harbor safety committee and we have been doing it for about two years+, 2 1/2 years trying to get this done unsuccessfully. So I'm so glad that both of you are there because this panel it tells them where I was coming from and thank you for inviting them, very grateful.

>> LINDSAY GEE: Thank you, great panel definitely. I just want to touch upon, thank you all for emphasizing the role of the metadata in the commentation. But also the standardization not just the metadata but the data is here we have Corp, NOAA, and Christi so would be nice to have a standard, it could be the sum you know it could solve the problem but we need everybody when they produce the data, not only documented but also the conversion like Quentin brought, if everyone brings different data and different format and then what to do with it? So it would be nice from the beginning like nationally if we all follow the same, the same technology whether we like it or not.

Whether --CCTV or Hydro bathymetry, imagery, whether lidar, topo, all the same, we just need to single is how it is produced and delivered. Thank you.

>> BRyes I definitely agree on something we have been documenting promenades these I don't think you'll ever get the same format from everybody particular always be asymmetries there. When you develop products and making sure that you are document a now and is incredibly important and that falls all other the umbrella of metadata so that is a great one.

>> LINDSAY GEE: Starting from the different type of data and the senses I think we talk about this but it is one area that we are coming, if you of us has is one of the standards and standards lead to metadata in the initial phase. I think we are on sync with that. And more of that to see on the tracks to what we are talking about here. Totally support that, thank you.

>> KATRINA WYLLIE: I want to add on well a big effort to update the specifications and that's out for public comment and I think the big push was there to standardize the metadata regardless of-- doing and having defined-

minimum metadata. And so there is a conservative effort going on with this fiscal year to understand what is the minimum metadata? And how do we make sure that everyone is on the same page at least with the NOAA and how that data comes in where it comes in. So that is definitely a really big challenge. Because we all know it's important that we all need to speak the same language to understand what we are asking.

>> LINDSAY GEE: Yes.

>> Thank you, question for Leslie. So as the panel we are working on issue paper for the ministry are about digital twin. And that is awesome and I wondered if you could provide us input on the data from NOAA that you are using and what thoughts or considerations or what type of role you can see?

>> LESLIE RUTA: None [Laughter] partially because one of the other things in addition to the GIS that falls under the planning at the port of Corpus Christi is funding. And we were able to fund our digital twin three port security grant. So if you write them correctly, you can get them funded.

That is good thing. It is literally the first bite of the elephant, we are starting the digital twin in the security space. And I believe that this time we are looking at AIS on vessels. And also going to do all of the rolling stock so that we can see where our officers are. In the next step is where we are going to get into the more NOAA you because we do have ports in Corpus Christi and so we do have a lot of that NOAA data and it is the next phase I don't even want to call it a phase because there's so many steps but that is where we are starting first.

>> LINDSAY GEE: I guess I'm not sure how long you want to go Julie just--

>> JULIE THOMAS: Okay just want to make one thing. For the digital twin paper, it might be nice just to reference, if it was okay with you, that there are ports that are exploring digital twin for movement at this time or something like that. We don't have to go into details.

>> LINDSAY GEE: Yes Sean a final comment unless there's anyone else with final burning comments?

>> SEAN DUFFY: I don't really have another comment other than to say thank you and we will go to a recap pretty quickly here. Since we did get our schedule off but I think it was good that we allow that panel to complete and a lot of

good information. So thank you as we move into the recap.

>> [Applause]

>> Okay so recapping.

>> Don't forget administrative letters when you're recapping.

>> **NATHAN:** Okay I didn't have a whole lot there was something Doctor-- yesterday that was not brought up in the recap about his discussion about protecting IP and I thought that was especially with accelerators out there for develop might technology and working in the small businesses about that was really interesting topic and something that to consider going forward. And that is it.

>> B Datum. I thought the presentation was really good and the importance of filling those gaps and the metadata and as far as the math and science, any support we can give her that I appreciate that.

>> **SEAN DUFFY:** Just keep it moving down the list yes it would be you Mr. --

>> Thank you the only thing I would recap is, I didn't get to ask the question, I have a question we outside the boundaries of what would be considered normal.

When you see that big long list of oil companies and tankers and tanker owners, isn't it in their interest to spend a bunch of money and maybe build a digital twin? You know? Especially when you pay \$6.20 for a gallon of gas in California. But anyway. I will skip to--

>> **JULIE THOMAS:** But they are paying for in Long Beach I will tell you. They are paying Charta, that is for marathons or will they are funding the digital twin in Rotterdam right now.

>> **GARY:** Okay great. So the only other thing I wanted to add was a couple of thank you's, in addition to what we talked about this morning this will be my last meeting and has been great and Kevin and your whole staff and especially all the support staff here, or of the reason this is always been really great was all of the NOAA folks made a great. I want to let you know that I really appreciate it. And thank you to you Julie for stepping up and really leading everybody in these last couple of years. It has been super. And I wish Sean and Nathan a lot of good luck in the future. And I know you guys are going to go great. So thank you.[Ed speaking]

>> The publicly governmental safety data by the ports needs to be resourced by the government. Thank you.

>> SEAN DUFFY: All right Captain McIntyre you are up next.

>> All right already took my time today so I will succeed my time to the next.

>> SEAN DUFFY: Deanna. Lindsay.

>> LINDSAY GEE: I have taken up my time with every to so I will succeed to the next.

>> SEAN DUFFY: Is Doctor Alcoa billable online?

>> NICOLE ELKO: Yes.

>> SEAN DUFFY: Hey there your.

>> NICOLE ELKO: Can you hear me?

>> SEAN DUFFY: Yes we can.>> NICOLE ELKO: Can you hear me?

>> SEAN DUFFY: Yes we can.

>> NICOLE ELKO: Fantastic. All right. So thank you everyone for the panel and I will make my comments with respect to that and a shout out to the directors about some of the hard questions that we often politely don't ask during the panel.

You know the things that are super challenging for them and that was kind of what we intended to bring to light.

With that panel and I think it was done very nicely. So I thank you all very much and trying to get out that question of where are you already overextended in terms of hydrographic data collection if you had one more dollar it will be spent there and then how can we kind of advocate for additional program think the address those formation areas and + a few resilient data that is probably already being collected at some level.

So I was really excited to have that conversation and I hope that it will continue. Thank you.

>> SEAN DUFFY: Thank you, I will skip myself and come to Kevin Cruz next please.

>> Yes great session today. I want to emphasize that the importance of the conversation that we had for lunch about ports. Really should work on that one, extremely important for the nation and so on. And the resilient panel is always at the topic especially for the people like us that we live on island. And we get hit by not only hurricanes, earthquakes and Earth warming [Laughter] so really sit still and we are their. I really enjoyed the last panel because it brings the technical and operational side of the ports business. And we should be looking more into that. And it should be wrought into more practical, we

do, which you will see more often

the next meetings. Thank you.

>> SEAN DUFFY: Thank you Captain. Captai Chopra.

>> Thank you so much, great day and perfect pals and thank you to the what team and getting those panels together and I echo what Captain Cruz said today we saw where the rubber hits the road. Someone's wasting data was processing it. And we saw the result of it right there. So to me that is where we need to be that as a low hanging fruit. But has maximum economic impact. We are the Department of Commerce. We need to promote, NOAA need to support and promote U.S. businesses and getting this done. Thank you.

>> SEAN DUFFY: Thank you. Qassim.

>> DR.QASSIM ABDULLAH: Thank you it was a great day, really enjoyed the modeling team led by the efforts led by Doctor-- and they did a great job differently. So the panel, Rachael led on the directors very informative. And on that I just captured what one of my-- were on their first and Katrina working on connecting land and sea, the land and I think as a panel we should give them the right support to the level of tissue paper on it and is very important that as a nation we need to all connected definitely.

And that, takes me to the resilient panel, I really enjoyed it as well. Because what I'm talking about about connecting the land and sea has a great effect on coastal resilience and modeling. And you know, that right now often --slide you really need to not only 50 m or 50 feet of things like that.

The quality and accuracy is great to see the emphasis on the data quality, metadata and standardization, so thank you all it was a great day.

>> SEAN DUFFY: Thank you Qassim. Mary Paige.

>> MARY: During the afternoon session I have to admit I was smiling when I heard a comment that said you draw a line for the route on the Mississippi. I was deeply offended because I wanted to hear you plot your course. So. You can draw a line. [Laughter]

Anyways. What I did hear a lot today, and I really hope that people, there is a methodology to communicate everything. Because who, were the stakeholders purposes? Who is communicating this data collection? How is collected and where is going? Who is the single source? Where are you going to get that? Is that, to me it is NCEI but it is NCI is what I'm hearing. So is that it and if so are they being properly

advocated as to being a single source for this data collection? Regardless, what really her today and as an outsider of sorts is that for reliability stand -- purposes and holding responsibility if someone is using the data is that you are seeking or the peaks are seeking sufficiency and consistency. That was great that was a wonderful day.

>> SEAN DUFFY: Thank you we will go to the directors next, roughly not putting anyone the spot but director Snowden do you have some comments?

>> DERRICK SNOWDEN: Thank you I want to thank Nicole for her invitation to be honest about the challenges between addressing the core mission and maintaining the excellence with the opportunity and the pressures to innovate and do the things. So I appreciate that I think this group is what I'm learning it is a great venue to help us sort of expand our networks and to touch new customers and to help with that prioritization process. So I appreciate that.

Thank you.

>> SEAN DUFFY: Thank you. Rachael Dempsey do you have any comments, you are on the list and I wanted to say I really thought you did a great job moderating as you went through that.

>> RACHAEL DEMPSEY: Thank you I will just take my time and express on behalf of myself and Nicole, our thanks to those outgoing board members and she wanted to make sure that she had the opportunity and thank you in person, she apologize for missing that today. But again, thank you for your faithful service, we have benefited from it and we greatly appreciate it. I will not be here tomorrow. I just wanted to let you all know how wonderful of an experience this was for me to attend my first HSRP. I really enjoyed engagement which you can everyone of you. And I have learned quite a bit. And I look forward to seeing you all in the spring. Thank you.

>> SEAN DUFFY: Thank you. Juliana?

>> JULIANA BLACKWELL: I enjoyed all the panels today and I want to say thank you to the presenters that put the time and effort to pulling this together and the moderators and I think everybody did a perfect job and I hope we all got lots of good things out of it. And my mind is still kind of swirling with all the information that was presented. A great job by all. Thank you.

>> SEAN DUFFY: Thank you. Andy?

>> **ANDY:** Yes thank you I also appreciated and enjoyed all of the panels today. My comment about the resilience panel and particularly I noted and Nicole slide indication of the data gaps and the demands for the resilience problems.

And I think it is going to be important that we sort of carefully identify what those data gaps are and so that we know what needs to be done to fill them rather than have them sort of as some generalized statement of data gaps. But let's make an effort to try to list those things so that we can, I thank you know, we might be able to address them. I would like to see that sort of pursue a little bit. Also, Sean, thank you for the Sensor panel. And the panel itself, in that regard I appreciated the fact that they indicated discussion with the users and the stakeholders in pursuing those sensors studies.

And I like the sort of analytical approach to the study needs, the basin study engaged. And I thought that was very well laid out. I applaud those presenters.

>> **SEAN DUFFY:** Thank you Andy.

So I will start off by saying first, you know it is kind of interesting ever since I have got on this panel of course, I've had Ed, Kinzie GN Captain McIntyre and Gary is now noted subject matter experts. And is going to feel weird for you to not be here anymore. But I just want to say that each of you made quite an impression on the panel. Thank you for your service to the panel. As we generate as teams do. And we have new members coming along.

Welcome to some of the new members that we have with us today! I won't dazzle you with much other than to say it was a very long day with a lot of moving pieces. And at the end of the day you kind of go back to what you know and we still have salty water on the Mississippi River. I'm still getting text messages, pictures explaining this kind of information. And you know having some of those sensors down the road might be helpful. Some of them are. To measure salinity.

What also I want to say Julie, thank you very much for serving as chairperson. It is going to be a lot to step up, I have confidence and my friend from Alaska. We have worked together but there will be some new dynamics on some of the panels as far as not only chair and may be some of the working groups, I think everybody for what you do, I think the last two days have been great meetings. I

know tomorrow we have, so we will see little bit more brilliance for tomorrow. But thank you everybody for the day. I really appreciate it and Julie I start to understand what you have gone through but thank you very much for your leadership and I will turn over to Admiral Evans. Thank you.

>> **BENJAMIN EVANS:** Thank you Sean and just by way of closing comments, Derrick was somehow once again looking over my shoulder because I also wanted, I appreciate Nicole's invitation to honesty around the challenges. And I think one theme that hopefully came through in both the data --I'm sorry the both the resilience panel and the data quality and accuracy panel is that number one going to the question about data stewardship, resourcing data stewardship both the NCEI and elsewhere is a tremendous challenge for NOAA. Is always the last thing in the value chain and it is comparatively easy to attract support and do data acquisition. And the further that you get down the tail the harder is to get people to understand to ask lane to people why this is important and why it deserves investment why it demands investment.

And getting to the question of if someone handed you another dollar, where would you spend it? Well I think we would never say no to more data. Let me be clear on that point. But I think from hopefully from Katrina's is attention in particular you see the real challenges of putting this all together. And so building automated machinery that allows us to bring together data from disparate sources, whether that is data that is acquired through our specifications on our projects or data from a wide range of other sources and potentially from sensors that we would not use for our own work. How do we put that together rapidly and just it, assess it and qualify it and then get into a format which is out on the street for people to use and do that quickly?

That is the fundamental challenge. And so if someone handed me a dollar that is where I would spend it right now. Leslie and I should add before Bri comes out of her chair that needs to be on accommodate them with uncertainty. [Laughter].

>> [Speaker away from microphone]

>> **BENJAMIN EVANS:** Appropriate to support digital twins, yes. But lastly and then I will just repeat some of the comments that at breakfast this money just to get them onto the record. I deeply appreciate the service of all of the

outgoing members and I'm sure that we will appreciate them again tomorrow knowing that you at least won't be here tomorrow, I wanted to get that onto the record while you are here.

And I hope that we will continue as in the long tradition of the HSRP, that while you may no longer be official members of the panel but feel free to offer myself and the other directors the benefit of your advice when you feel is appropriate to do so. Yes. Thank you.

>>JULIE THOMAS: Okay I'm just wanting to, I really felt badly Marian because I had two people that had questions, at Mary time, but it don't even know who they were because they were kind of behind. Somebody, two people raise their hands but when we were leaving with questions. Okay. And Mary I will be here tomorrow. You will not be here tomorrow. Good to know. All right. If you have a question for Marion, her now. Okay no, that is fine it is meet tomorrow at nine AM. Breakfast as usual in the room next door. The meeting starts at nine AM. Thank you all very much.

[Applause].

>> And Nicole Elko online give you all a thumbs up. [Event Concluded]