NOAA Nav-cast Transcript
S-100 for System Implementers
Julia Powell and Dr. Neil Weston
June 18, 2019, 11 a.m. (EDT)

Lucy Hick: [1:58] Hi everyone. Welcome everyone to our first NOAA Nav-cast, our new quarterly webinar series that highlights the tools and trends of NOAA navigation services. My name is Lucy Hick and I am the acting chief of Customer Affairs for NOAA's Office of Coast Survey. I'd like to introduce our speakers (for those of you that don't know them). Julia Powell is the deputy director of the Coast Survey Development Lab and the chair of the International Hydrographic Organization's S-100 Working Group. Neil Weston, is the Technical Director of the Office of Coast Survey. Today's presentation will focus on the S-100 Universal Hydrographic Data Model and what navigation system developers need to know in order to implement various S-100 based product specifications. The talk will also focus on what NOAA is specifically working on in the S-100 product development space for S-111 surface currents. The key areas that will be discussed are S-100 data model and what developers need to know, S-98 - S-100 interoperability specification, and S-111 surface current implementation. We have a fairly lengthy presentation, so what I'm gonna ask is if anyone has any questions or comments, please type them in the comment box on the webinar. If we have time, we'll get to the questions and try to address some of them. If we don't have time, we will follow up afterwards. So, with that, Julia…

Julia Powell: [3:31] Thank you very much, Lucy for the opportunity to do the first inaugural Nav-cast and we're really excited to talk about S-100, more specifically for system implementation, rather than for data production.

[3:51] So, briefly, what were gonna talk about is at a very high level, what is S-100. Then from an implementation level, what do you need for S-100 for various product specifications. We'll touch on this concept that we've been introducing called the S-100 readiness level so that you as a developer will actually know when is that specification ready to go operational. A little bit about encoding, schemas, the S-100 catalogue, discovery metadata, interoperability. And then I will hand it over to my colleague, Dr. Neil Weston, who will talk about the NOAA S-100 implementation, specifically for S-111.

[4:37] So, for those of you who don't know, S-100 really is the IHO building block and it provides the data framework for the development of the next generation Electronic Navigational Charting products, but really other digital products required by the hydrographic, maritime and GIS communities. That's sort of one of the issues that we have found with the existing S-57 framework is that it really is just tuned for electronic navigational charts and it does not have the capability for other types of products, such as water levels, surface currents, and other applications that are being used by the GIS community and greater hydrographic community.

[5:28] So, S-100 is actually moving beyond the IHO. A lot of other international organizations, related to maritime applications are leveraging S-100 to develop different product specifications. So, the IHO is sort of focusing on the hydrographic domain, such as ENC, bathymetry, water levels, surface currents, under-keel clearance, and marine protected areas. The WMO is focusing on ice forecasting, on ocean surfaces, and also on weather forecasts. IALA, which is the International Association for Lighthouse Authorities has what we call the S-20x space, and they're leveraging it for VTS and aids to navigation.

Sort of exchange of information. The IMO has designated S-100 as one of their foundational specs for the e-Navigation solution and then also IEC is developing the S-412 route exchange format for use.

[6:41] So, really what does S-100 really mean for the maritime community? It leads to a global consistency of products. But this is what's really important on the development side. It specifies encoding formats, based on product type. So, if you are implementing at a product specification level, there's a specific encoding assigned to the product specification. What that means, as an implementer that you've only implemented a specific encoding. And if a new product comes along that leverages a different encoding than is specified by S-100, it won't have that plug-and-play capability, which is one of the reasons why we stress for implementation to look at the S-100 level. And S-100 currently specifies three different types of encoding. We have the traditional ISO 8211 for S-101 ENCs. This 8211 has been adapted to leverage some of the GIS framework as specifies under the ISO GIS standard. So, slightly different from the traditional S-57 ISO 8211 encoding. Then we've also adapted an HDF5 from the HDF5 group. And the S-102 bathymetry, surface currents, water level, and gridded weather information will leverage that format. Then, we've also adapted GML from the OGC GML spec and given it sort of an S-100 flavor. And that's gonna be utilized for the S-412 for vector weather information, marine protected areas, and things like under-keel clearance management. But the big thing what it does, it moves to a machine readable catalog mechanism. So, it has XML-based catalogues that allow for machine-to-machine readability of data.

[8:44] So, if we do a little bit of a deeper dive into S-100, I will readily admit that it's a very big document and has a lot of different parts to it. Right now, we're at fifteen different parts. And it defines things like out register structure, how we manage our geospatial registry, where we store all of our real world information that then gets tied into feature catalogues. It defines the general feature model and has the modelling for the real world for machines. Defines all the metadata required, feature catalogues, so how we build our feature catalogues, coordinate reference systems, spatial, which is otherwise known as geometry, imagery and gridded data, different portrayal mechanisms, the encoding formats, which I spoke about on the slide before. We actually have now a scripting language to help with some of the portrayal implementation. We've also implemented online communication and data protection, otherwise known as encryption.

[9:51] So, the key thing is as an implementer, where do you actually find information? And this link (and we'll make the slides available as a PDF to everybody). But, this website is actually maintained by the IHO. And what it does is it links to the latest edition of S-100. And it provides links to where we store the S-100 schemas, which are actually stored on Github. The S-100 UML models, which are downloadable via Github. It also has the links to an HTML version of the UML models. So, S-100 is a model-based framework. So, its whole foundation is on the unified modelling language. So, it's easily adaptable for system developers.

[10:43] So, the other thing is that people ask. So, when the IHO published something, where is the actual final thing published? And the IHO publishes on the S-100 Geospatial Information Registry. And this link points to…it's currently on our beta registry. But these are all the official public published S-100 based product specifications and the latest version of S-100.

[11:20] And once you click on one of those links, it actually brings up, for example, here is S-101. This is Edition 1. Talks about the abstract, what it is. But the key thing, what it has, is it provides you a link to the actual document. But it also provides a link to the version of the feature catalogue and a version of the portrayal catalogue that was published along with that specification. So, this is where, as a developer, you actually find the specific feature catalogue and portrayal catalogue that you would require, you know, when you upload and new information comes. We're also working on, you know, a place where we can publish test data, for these different types of products. For example, there the converter that ESRI has provided for S-57 to S-101.

[12:22] So, the IHO is sort of in the process of really beefing up its testbed website. So, for example, here, the IHO also maintains a testbed registry. This one is password protected, so you would have to register for it. But, what it does, is it actually provides you with all the latest versions of the different specifications that are in work, in terms of what's going through the approval process. So, for example, we have already published out Version 1 of S-102. And Version 2 is due to come out late this year. So, it's currently going through the approval process. But this is where you can find the latest S-102 information.

[13:05] The other big thing that we're looking at implementing. Or that we've adopted at the last big IHO meeting is this concept of S-100 readiness levels. They've been adapted from the NASA technical readiness levels. And the intention is to show what is the readiness for operational use. So, it allows the non-IHO stakeholder organizations to gauge when their development will meet an appropriate readiness level for transition to live operations. So, for example, when the IHO publishes and Edition 1 of a product specification under S-100, that's really the testing and development edition. We feel that it's stable enough to move into a testing and development phase. It is not stable enough to move necessarily into an operational phase. And it has to have certain components in order to get to an Edition 1 for IHO approval. And then we have a fairly, what we're trying to implement at the IHO level is a more iterative development process to get to Edition 2, which is considered the operational phase. But, as you move through your iterative development, we feel that looking at it, you have to have certain key components of the product specification in order to go operational. And then we also feel that there are certain key components when that specification is designated as front of bridge, as it will be used as a navigation system, and in the long into an ECDIS, it actually needs to be part of the overarching interoperability specification and have alerts and indications built in and have sort of operational data. So that's when it's on operational. So, this is one of the things that we're pushing forward through our product specification development lifecycle to hopefully make it more transparent to the wider community where we're at in terms of development and operational readiness.

[15:22] So, one of the key things that S-100 has, which really makes the machine-to-machine aspect for when we update a product specification are machine readable XML catalogues. And one of the big ones if feature catalogues. So, feature catalogues in the old S-57 world was a gigantic paper document that system implementers would have to hand-build their implementation of that document. This time, it's actually already in a machine readable format. And what this does, it binds our features and attributes together, ties in spatial primitives (points, curves, and surfaces). And here's sort of a snippet from S-101 to show everything is sort of appropriately tagged. And this is conforming to the S-100 feature catalogue model.

[16:24] The other one is that we have S100 based portrayal catalogues, which is also a machine readable set of symbols and portrayal rules. One thing I want to stress for system implementation is S-100 now defines two types of portrayal mechanisms. One is LUA, which is used for S-101 portrayal and is best for portrayal rules that need to use external conditions to generate the portrayal. So, for example, if the portrayal is affected by something like the ship's draft, that product specification will use LUA for their portrayal mechanism. Otherwise they'll use the XSLT mechanism, which is a simplified rule, based on XML style sheets. This is where I have it in red. Navigation systems must implement both for it to be interoperable and for it to be able to leverage the portrayal catalogue, built by different product specifications.

[17:27] The other thing that's really robust within S-100 is the S-100 discovery metadata. Discovery metadata allows for automated tools to discover the semantics of the data within the datasets. S-100 is a profile of the ISO 19115 metadata profile. The one big change from ISO 19115 is we make metadataIdentifier mandatory and we validate it via the S-100 schema definition and the S-100 Schematron metadata rules. And those schemas are available via the links that I had shown earlier in the presentation.

[18:27] The big thing about discovery metadata, it facilitates information exchange. And it's implemented utilizing XML exchange catalogues. And those catalogues contain metadata about the overall exchange catalogue, metadata about individual datasets, and metadata about the support files that make up the complete package. At the S-100 level for metadata, in the discovery portion, most everything is optional. But at the product specification level, the restrictions will occur. So, not every specification will use every metadata field. But from an implementation level, implemented at the S-100, so then if different product specifications have different parts of metadata information, you'll be able to read it all.

[19:21] So, in terms of metadata, some has changes in terms of our traditional mechanisms, but some has not. Datasets are packaged up and delivered usually via a .zip file. There is an XML instance that really shows sort of the deep dive into the metadata. So you would be able to write a script against that. Metadata catalogues actually define where in the world the data is. It has different sections. It can deliver a feature and portrayal catalogue if needed for an emergency situation. I think for most applications, the feature and portrayal catalogue will not get delivered. But it really talks about, it really is about delivering the different datasets and different support files.

[20:12] So, the big thing to stress is that it is an XML for machine to machine data discovery.

[20:21] Here is sort of a snapshot of the UML or part of the UML model that really shows the different types of metadata that are discoverable for various types of datasets. So, for example, you'd be able to find the file path, if the data's encrypted, the scale of the data, the encoding format. So it really does deliver everything that you would need in terms of being able to automatically get the data for where you need it, including things like the bounding polygons of the datasets. So, if you're looking for just-in-time data delivery for latency, you'd be able to write a script based on ship's parameters to be able to scrape and figure out if there's a new dataset available and then go find that where it's stored in the world and then deliver that. Versus having to maybe deliver the entire regional dataset that may be packaged up.

[21:25] So, here's more of a snapshot of the XML of the different metadata that's contained.

[21:34] So, what we're really doing…a little bit about what NOAA's doing…is that we're really looking at building out a central metadata database to handle datasets, metadata. And then the XML will actually allow for discovery. So, it will let you know when new data is released, where data is stored, where it is geographically, what type of data it is and who produced the data.

[22.02] A little bit about how we're looking at it for data dissemination, before it turn it more specifically over to Neil. When we're looking at file sizes, and this goes to some of the IHO guidance that we have when we build product specifications. Because people ask, "why are file sizes still limited to 10 megabytes?" And we say, a lot of it has to do about data dissemination and when you're trying to deliver a new updated dataset that has a lot of information, you still have to be cognizant about how that data is delivered. And most of us on shore-based services, we're used to fiber connection. If not, our LTE 4G phones. If not, we're up to 5G. You know, it gets faster. Then you still have to think about that there still a lot of data that's delivered via satellite and Inmarsat. And that bandwidth, you have to really pay for. So there's still considerations to that lowest common denominator in terms of data delivery.

[23:13] The other big thing that we're looking at…and this is really for the navigation systems…is that we've developed what we call S-98, which is the S-100 interoperability for navigation systems. And that is a framework for capturing interoperability rules for use in ECDIS and what we call "front of bridge" systems. So, that could even be a portable pilot unit, and ECS. What this gives you is a machine readable mechanism for rules for the different products that may be loaded in conjunction with each other. And we're looking at harmonized graphical presentations for these S-100 data products.

[23:57] So, this is sort of a bit of a snapshot. This is what we're aiming to get. Although we still have to work on our harmonized presentation. So this is using a traditional shaded bathymetry. But we need to look at sort of better rules and say maybe what we're looking for is the two color safe and unsafe traditional water presentation that's used in ENC for S-102 bathymetry. You can see we have surface currents. But you also see your primary navigation information that you need, such as regulated areas. And your shoreline is viewed appropriately on top of your bathymetry. So this is what we want.

[24:43] But this is what we don't want. And this is sort of what you get if you don't have any rules. So you can see that you bathymetry dataset is leeching over the shoreline construction. Your surface currents, they're fairly dense representation right now. The colors probably need to be adjusted. If you look at it on top of an ENC. That speed and direction color is very much similar to one of the ENC shades. So, there has to be care given in terms of what portrayal should be used for what products in a front-of-bridge system. So, for example, I say magenta should be a reserved color for electronic navigational charts. Because if every product that's considered front-of-bridge uses magenta for something, the navigational significance of magenta is diminished. So there has to be some sort of rules and hierarchy applied for portrayal and for color selection across the different product specifications. But they also have to work together and in different lighting conditions. So, there's a lot of work to be done in that space. However, for other products that aren't necessarily designated front-of-bridge, there really doesn't have to be a whole lot of portrayal harmonization and/or rules. And you can have a lot more freedom in that display of information.

[26:14] So, the key takeaways that I want to talk about before I hand it over to Neil is that you really want to implement at the S-100 level to ensure optimal plug and play. The harmonization of data is something that we're really working on at the IHO and the S-100 working group level, including improved interoperability. And the thing that I stress is that if data producers move to leveraging consensus based standards…and this comes from different hydrographic offices…it actually leads to lower implementation costs for the manufacturer, which can potentially lead to lower costs for the consumer that leads to an increased uptake of the product.

[26.54] So, I'm gonna turn it over to Neil, who will talk about operationalization of S-100 at NOAA.

Neil Weston: [27:07] OK. Thank you, Julia. So, Julia did a great job explaining the S-100 framework, so what I'm going to do now is take it to the next step and we're going to talk about surface currents of S-111 data that uses an S-100 framework. So, here at NOAA, the Office of Coast Survey, were developing a system to disseminate OFS surface current data. So, OFS is Operational Forecast System. And we'll say a few words about that in a minute. So, the system that we are developing has been around about 12-15 months now. So, we're finalizing that. It's designed for use in electronic navigation systems with ENCs. The data is designed to be interoperable with other systems. And the product specification is based on the S-100 framework. So, the surface current spec was adopted by the IHO earlier this year on February the 13th.

[28:14] So, a few words about operational forecast systems. So, NOAA operational nowcast and forecast are models that run. They're very sophisticated. They run 24 hours per day. And typically they output some parameters every 6 hours. They're fairly complex and they do support NOAA mission goals and priorities. So the other parts of NOAA that are involved in producing these models. Some of the data that feed into the models and come out of them are water levels, wind, water temperature, salinity, and currents. And then the operational forecast system has three main components. So, you have the hydrodynamic model predictions. There's the product dissemination component. Of course quality control, as we monitor that.

[29:09] So, this chart, which I apologize is a few years old. But at the time it was produced, it showed the domains, where operational forecast systems are available. So, if we start in the northeast. The Gulf of Maine, that one is operational now. And the same thing with New York and Chesapeake Bay and Delaware Bay. So as you move around the Atlantic Coast, there are a number of models that are readily available and some that are in the first or second stages of being developed. The Gulf of Mexico…I think that's almost operational. Is that correct, Ed?

Ed Meyers: Yep.

Weston: I'm getting the nod. The Great Lakes is covered. Cook Inlet is Alaska is operational. I think they're finishing off the west coast. So, West Coast OFS. The goal is to have coverage along all of the coast of the United States and main areas.

[30:00] So, now, let's zoom into the lower Chesapeake Bay. So, here we have a map of some discrete stations that provide input into a typical OFS. In this case Chesapeake Bay OFS. And what I mean by discrete is the measurements are only available at those locations. So, anywhere that you don't see a red bubble or station, we would need to get measurements from there from an OFS. So, this would provide input to an OFS and output we would have in a gridded format. So, model inputs here, we have winds, water levels, and currents. And the outputs would be refined water levels, currents, temperature, and salinity.

[30:57] So, some of the things that go into developing an OFS, in this case the Chesapeake Bay. On the left side of the screen, the generation of the nodes or the spacing of the nodes. And here you can see roughly just over 78,000 nodes went into this model. And in some areas, you can see the node density is much higher than in others. That just provides greater resolution. The other component that goes into generating a model is you need the bathymetry. So, on the right side, you can see the Chesapeake Bay. And the color bat shows you the depth. So, I think 35 or maybe 40 meters is the deepest. So you can see that that's not very deep. So, the higher resolution bathymetry we have, the better modelling and the outputs.

[31:49] So, for simplicity, what we tend to do is take irregularly space nodes for a grid system and make them into regularly spaced. The main goal here is for simplicity in integrating between points and for displaying on like a graphical interface. So, we just want to simplify the process. The node spacing in this case is a hundredth of a degree in the x and y direction. I think that most of the models that we've looked at so far, it's similar. I think San Francisco has a slightly different spacing. But we are looking to improve upon that as time permits and we have resources.

[32:40] So, the next thing I want to talk about is some of the metadata for the surface currents. So, the two IHO specifications that pertain to surface currents. Of course we need the S-100 and the latest edition is 4.0. And for S-111, it's edition 1, which was available earlier this year. Those are the two main documents that you should look at if you have an interest in diving deeper. The format for the data, that's in HDF5. And the parameter that we're looking at is of course surface currents. But we are working on water levels, so you should look forward to that product coming out in a year or so. The coordinate system that we use is WGS84. That's a worldwide system. So I think most mariners are comfortable with this system. The frequency that the data becomes available is typically four times a day. Here, I've listed 0, 6, 12, and 18 UTC. One caveat to this is that not all of the models start at the same time. So, there could be staggered outputs. But typically you get outputs 4 times a day. The duration, for the most part the data is available in either 48 or 72 hours. For a dataset that you download, you can increment each hour, you can see how the surface currents are changing out to 72 hours. The time zone system that we use is UTC. And the resolution (I think this is for Chesapeake Bay) is roughly 500 meters. So, we are going to try to improve on this, again, as resources permit. Now, the depth here, I've listed at 4.5 meters below the surface. The model actually outputs several different layers. So you can get the depth at different…But for the maritime community or the IHO, they've chosen to provide depths at 4.5 meters because that those are the surface currents that most impact a ship or marine transportation. The data coverage…as I mentioned earlier, we have Chesapeake Bay, Delaware Bay, New York, New Jersey. And I think this particular model for the Chesapeake Bay is a hydrodynamic model…Regional Ocean Modelling. So, ROMS.

[35:17] So, this next slide shows the lower Chesapeake Bay. And what you see on the screen are four different cells. This is NOAA's new chart rescheming. So, each of those cells is a band 4 ENC. And so in the center of each cell, you can see the naming convention. US4VA. So, US, band 4, Virginia. And then you've got a sequence that increases as you go from south to north and then from west to east. You can see it's increasing by letter. So, again the format is S-111 with HDF5 encoding. I've listed the grid resolution in this example. It is surface currents. WGS84. There's 72 hours in the dataset and you can increment per hour. And this particular dataset was generated from data taken from December 3rd of last year. And there's the time. So, what you can see…you can see the surface currents in sort of a heatmap, using the color bar. But, what you cannot see on this chart is the direction of the currents. So, if we go to the next slide.

[36:33] This is another way of portraying the surface currents. So in this case, you can now see the currents with a vector. So, the magnitude of the vector can be read off from the color bar. Now we did talk about, or give a similar talk a week or two ago about the color bar. And there was some discussion about are these optimal colors? And Julia and I and our colleagues believe that there's still refinement to be made. So that may not be the final color bar that we will have. It's going through checking and things like that to make sure that it's optimal and works with ENCs and so forth. So, don't hold us to it that this is a final product. It's still under review.

Powell: [37:20] That's were that interoperability portrayal harmonization comes in because this portrayal is showing the official S-111 portrayal. But you can see there's some issues that may need to be worked out.

Weston: [37:35] Yep. So, if you toggle back and forth between these two images, you can see that at the entrance to Chesapeake Bay, the red shows a current of almost two knots. And on the vectors, you can see the colors approaching almost a greenish color, if you will.

[37:55] So, now, what we've done here, on the right side, we've produced ENCs or datasets that correspond to each of those cells. And so if a mariner wants to download a dataset, they can get data that's confined to the boundaries of the cell. And we've put them all together to the three models that you see here. So, New York at the top. And then Delaware Bay and Chesapeake Bay. You can see how they overlap nicely. And this scheme can continues down the eastern seaboard. The same parameters on the left side. This is just showing you as we merge them all together. So, again, this is band 4 ENCs.

[38:41] So, we can of course extend this. And so our colleagues in OAR, they actually have data for the entire Atlantic and Pacific basins. So, what we did…the S-111 colleagues, or the team, took surface currents from RTOFS, real-time operational forecast systems. And here we have band 2 ENCs. So, these are much larger. But you can clearly see in red, the outline of the Gulf Stream. You know, going from the Gulf of Mexico, up around Florida, up along the coast and off to Europe. So, why is this important? Well for some mariners, if they're a ship transiting from the east coast to Europe, they could make use of part of the Gulf Stream. If they just navigate in it for a period of time, they could gain a knot or two. Decreases fuel. So, you're now seeing infrastructure make use of environmental components, such as the surface currents to optimize their transit. The Admiral of the Office of Coast Survey is providing this data because, at the moment, we may be the only ones doing this. But as more countries start producing datasets that are more accurate, we will cease producing these coarser products and allow different nations to provide much higher data quality and data sets. So, we're just doing it as a courtesy to the maritime community.

[40:26] Again, this is just a repeat. But now, along the coast and in the gulf and the Great Lakes, you can see the band 4 ENCs…how they all fit together. And so, as a ship approaches, anywhere along the eastern seaboard and the Gulf of Mexico, you can choose the ENC set you want and you can download the surface current data that corresponds to that. So, it's sort of like a package.

[40:55] So, this next slide actually shows you the different uses, different communities that use operational forecast systems. So, hydrography of course. Surveying, deep sea mining, charting, and EEZ surveys, so forth. On the upper right, you can see shipping. You've got precision navigation. I've got an asterisk about that. So, I'll talk a little bit about precision navigation. So, that's sort of a concept of where a mariner can go to a…let's say one source or one location to get different types of data, such as

ENCs, surface currents, bathymetry, and so forth. It will just simplify the process of the mariner getting information, rather than going to ten or twelve websites.

[41:50] So, the precision navigation concept that's underway at the moment, or being developed started out with a question or computation. We wanted to make sure we understood what problem we were trying to solve and then look at it in various representations. I have real-time data coming into the star. A key component of precision navigation is, of course, structured data, which Julia discussed nicely in the S-100 presentation. You definitely need structured data for this, once the concept becomes a reality. In part of my talk, at the beginning, we talked about algorithms. So, the OFSs are complex algorithms that run. So output from them will feed into precision nav. And in the end you will get various products that come out, whether they're refined bathymetric charts, or higher resolution data from a PORTS system, so forth. The bottom five smaller graphics show you products that we envision will come out of precision navigation. Some of them may be available now.

[43:08] So, some of the economic benefits for precision navigation? We can have a single streamlined decision support tool. And that's to optimize channel depths, if you will. We can visualize data and the environmental conditions. So, if a ship's coming into Chesapeake Bay or San Francisco Bay, it can see and visualize the data in near real time. The system will actually provide streaming information on current, water levels, salinity, a bit later on. And the goal is to have all of this use IHO standards and specifications, which of course uses the S-100 framework. The economic benefits: increased margins of safety, increased cargo capacity, less delays, decreased fuel usage, and so forth. So, you want to fully utilize the port. And the actual picture of the ship going under the bridge…those ships are getting larger and larger. So, the clearance between the top of the ship and the bottom of the bridge is being decreased. So, the more cargo and resources we can move into a community, the more efficient it becomes.

[44:31] Of course all of this isn't without challenges. Today, there are many charts that are available that do not meet the needs of all the mariners. We need higher resolution. Of course, we need real time information. Lower under-keel clearances on many rivers. Those a very dynamic environments. Waves can often dominate in wintertime. San Francisco, the Gulf of Mexico. You have storms around. That can change things considerably. So, if we can get that information in near real time, the mariner has a chance to make a more informed decision. Air gaps on bridges…they're getting tighter and tighter. In fact, sometimes a ship will have to wait if it wants to make a transit up the Mississippi. Wait for the right water level. We have a team of experts that are working on water levels to integrate a model for the lower Mississippi River and the Gulf of Mexico…the norther Gulf of Mexico. So, they're trying to integrate both of those systems. So, we can have very advanced models and forecast capabilities. Fog is often an issue too. Again, I know this in San Francisco and Houston-Galveston area. That's a concern. Something that my colleagues and I are discussing now, we're coming across vertical datums. And they differ, depending on where you are. So, the various datums or water levels are all along the Mississippi, eastern seaboard. So, if we're gonna build a national infrastructure, we have to make sure that we get all of the datums worked out. So, the information that we provide to you is tied to a specific datum that we actually share with you. So, we're gonna work through that. And of course discrete versus continuous data. One of the slides I showed station data that we consider discrete. So, observation data are only valid at those specific locations. And if we go to grid based system, the ideas is to provide observations of value to each of the grid nodes.

[47:05] So, the idea is to enhance and integrate all of this information into a decision support tool. If you look at the graphic in the lower right, you can see a pilot or a ship captain looking at I guess a portable pilot unit. Our concept of precision navigation is that many types of data will be available on a device like this, rather than having the captain run across the bridge looking at various instrumentations. Of course a prudent mariner will want to make use of all the data. But if he or she can get a lot of the data on that unit, that will simplify things. So, of course, this will allow us to reduce the risk. So, we get nowcast and forecast models that are very accurate. Chart information in the right standards. Our goal, or NOAA's vision is to continue to use and promote IHO standards and specs. And here, we've listed just three. The S-100 framework, which Julia talked about. S-111, just the surface currents. And I think S-412 is meteorological data, which will be available shortly. I think I've already mentioned portable pilot units and iPads.

[48:24] So, lastly, the dissemination. As Julia mentioned, we're building out the S-100 data discovery mechanism. And so, we're making great progress on that. The proof of concept…we're using S-111 data to actually validate the systems we're building. And next, or lastly, the initial operating capability. Here we have three or four different data types. The S-111 surface currents, that's sort of available now through our anonymous FTP. But to be fully operational, we want to have the metadata that goes along with these datasets available. So, we're anticipating it will be available by 2020, early 2020. And then shortly after, high resolution bathymetry. And then water levels. My colleague here is working on that too. And then the ENCs. So, I think that's the next slide.

[49:32] So, the next thing I'd like to do is I'll pass it back along to our moderator. If you have any questions for Julia and I, please tap them into the appropriate box in your panel. We'll see if we can access them and answer some of them in the time we have. Thank you.

So, at the moment, the moderators are just reviewing them. They're gonna select a few.

Question: [50:33] You have mentioned San Francisco many times in precision navigation. Is precision navigation coming to San Francisco?

Weston: At the moment, the team responsible for building the precision navigation infrastructure will include San Francisco when all the data is available. They have a robust platform. But because there is an operational forecast system that runs in San Francisco, the goal is to incorporate that in those data streams, eventually. But, I cannot promise a timeframe.

Question: [51:16] Is superimposing weather radar or lightening under consideration?

Weston: So, at this time, we don't anticipate bringing those on in phase one. But, we won't rule out revisiting some of those things. But, at the moment, what we want to do is get the ENCs, water levels, surface currents, bathymetry, the nautical charts, so forth, available in precision navigation. So, we'll start there first.

Question: [51:56] Could NOAA add S-100 support to GDAL?

Powell: I think we can investigate that. I know NOAA sponsors some GDAL updates for variable resolution grids. And I think we are in the process of working on putting the bathymetric attributed grid into GDAL. And I'm not sure that there's some S-100…

Weston: For those that aren't familiar with GDAL, that's a library of routines that will allow you to convert from one database format to another. And they usually are graphical in nature.

Hick: [52:39] I'm sorry. For those who are saying…I see a lot of comments saying that the slides were not updating during the talk…and I do apologize for that. For those who were unable to see the slides, we are going to post this on our website shortly after this. So, you'll be able to…and our talk was recorded. So, you'll be able to see the slides and the talk.

Question: [53:04] Where can we get the S-57 – S-100 converter and is it open source?

Powell: The converted is not open source. But, I believe you can get it from the…it may be posted on the IHO website or a link to it. I will have to check.

Question: [53:45] What do you think is the impact of autonomous shipping on S-100 and vice versa?

Powell: I think S-100 will probably improve autonomous shipping. Because a lot of it is machine to machine data and getting the data. I do think with autonomous shipping, ships don't actually need portrayals. So, we may be able to simplify some portrayals. Especially if it's a lot of shore-based systems that don't necessarily need that sort of instantaneous navigation picture. But I think that the stack of different data probably feeds into moving autonomous shipping further along. Because you can actually get it out to the ships and the decision-making tools together. Especially when you start getting things like the higher resolution bathymetry and the surface currents and the water levels and the under keel management systems. I think that S-100 is probably one of the key foundational things for autonomous shipping. But there is a notion that you don't really need portrayal for ships that have no navigators on board.

Question: [55:08] Is there any future development plans for Cook Inlet?

Weston: I think the way that operational forecast system models are developed, they usually run for a period of time and then they're refined 3-5 years later or when they need to refine them if there's an area that needs an actual improvement or a fix. Ed may have some more comprehensive answers.

Meyers: That's correct. So, in the Cook Inlet operational forecast system, it's going into operations shortly. As you mentioned, we'll be able to add features to it in the future, hopefully, such as ice forecasting and things like that.

Question: [56:00] What is a UKC management system?

Powell: A UKC management system is an under keel clearance management system. So, what that is, it's usually a shore-based system that takes in different parameters and runs a calculation for risk on whether a ship can go or no-go. So, S-100 has standardized how that data is disseminated. It does not standardize the actual UKC calculations. But if you've got a management system and it needs to get to a ship, here is the little packet of data and here is how it should portray on the screen. Tells the mariner were they can and cannot go, based on the risk calculations on water levels.

Question: [56:52] Does S-100 support data-streaming?

Powell: It does. And that was put in for IALA, who wanted online communication service. So, I'm not sure how IALA is going to leverage data streaming. Not sure how the IHO is going to leverage data streaming. But we've been trying to be very flexible in how to move forward. A lot of that has to do with how information goes through the pipe. So we not specified how that pipe is defined, but the types of data that can go through the pipe.

Question: [57:36] Where will this be posted?

Hick: It will be posted on the Coast Survey website. We don't have a URL for it yet. This is our first one. So, we will be posting it shortly. And we'll send out information about the URL, where it's posted to all of the participants, once we post it on the website.

Powell: And the other thing is Neil and I are working on an S-100 frequently asked questions, of which we've developed this presentation on. However, that still needs a lot more editing and formatting. So, I think we probably two months away from that. And we're not sure if that will go on precision navigation or our own website. Or both.

Hick: [58:22] If anyone has any follow-up questions after this, you can definitely e-mail them to Neil Weston (neil.d.weston@noaa.gov) or Julia Powell (julia.powell@noaa.gov) and we will also make sure that the questions are posted on the website along with the answers, once we figure out where we're gonna post them.

One final question…

Question: [59:00] Will model data be clearly distinguished from observations, so that users are not misled or confused by sometimes inaccurate currents or model parameters?

Weston: In the metadata, we intend to identify whether it modelled or observed. So, I think Julia mentioned, a key component to using the datasets is to actually look at the metadata to find out as much as you can of the data we collected.

Hick: [59:41] Thank you everyone for joining us for our first Nav-cast. We intend to do these quarterly. And so, we will also provide information about what our next topic is. Thank you to Neil and Julia for this presentation. It was really great.