Meeting Summary
Hydrographic Services Review Panel
March 9-10, 2022
Webinar

Wednesday, March 9, 2022

On the call of the Designated Federal Officer (DFO), Rear Admiral Benjamin Evans, NOAA, the Hydrographic Services Review Panel (HSRP) meeting was convened on March 9, 2022, via webinar. The following report summarizes the deliberations of this meeting. The agenda, presentations, and documents are available for public inspection online at

http://www.nauticalcharts.noaa.gov/hsrp/meetings.html

Copies can be requested by writing to the Director, Office of Coast Survey (OCS), 1315 East West Highway, SSMC3, N/CS, Silver Spring, Maryland 20910.

Opening and Introductions

Rear Admiral Benjamin Evans, Director, Office of Coast Survey (OCS), National Ocean Service (NOS), and HSRP Designated Federal Officer, called the virtual meeting to order at 12:46 p.m. He is honored to serve as the Director of OCS, succeeding his mentor and friend Rick Brennan, and is excited about the opportunity it affords to support the work of the HSRP. As he has worked with the Panel over the last few months, he has been impressed with the dedication and expertise the members bring to advising the NOAA Administrator on the agency's navigation services mission.

Julie Thomas, Chair, HSRP, acknowledged the people and businesses operating during the COVID-19 pandemic and its impact on everyone's work and personal life, as well as the great human loss. She welcomed RDML Evans to his new role, as well as the three new HSRP members – Alex Cruz, Tuba Özkan-Haller, and Nathan Wardwell.

Nicole LeBoeuf, Assistant Administrator, National Ocean Service, NOAA, discussed some of NOS' recent efforts addressing some of the nation's complex coastal challenges. NOAA and their federal partners have released the *2022 Interagency Sea Level Rise Technical Report* and are working to ensure they can get the information to decision-makers as quickly as possible. All of this work is underpinned by NOAA's foundational data, such as the National Spatial Reference System (NSRS) and tidal datums. Serving on the White House Interagency Working Group on Coastal Resilience provides Ms. LeBoeuf an opportunity to make sure agencies are aware of NOAA's mission. This interagency working group seeks to elevate, coordinate, and accelerate the federal government's efforts to increase the resilience of the nation's coasts and coastal communities, while also focusing on developing more equitable grant-making strategies. Ms. LeBoeuf is also NOAA's representative to the working group on flood resilience, which focuses on the work needed to re-establish and implement the Federal Flood Risk Management Standard across federal agencies. This work is possible due to NOAA's foundational data from their navigation services programs, including vertical land motion and bathymetry data. The information the HSRP will be discussing at this meeting is critically important and needs to be utilized by many different applications and across the federal government. NOS is in the initial stages of developing a strategic plan. Their priorities will include coastal resilience, diversity and equity, conservation and restoration, and the new blue economy. NOS will be reaching out to HSRP members and others in the coming months for input on the draft plan.

Congress has passed a budget for NOAA for the remainder of FY22. NOAA is still reviewing the details but it appears generally positive for NOS. The bipartisan $1.2 trillion Infrastructure, Investment, and Jobs Act (IIJA) provides major investments on highways, rail, air, and maritime transportation systems with a view towards the future. The IIJA calls for nearly $3 billion for NOAA, including support for coastal mapping, observing and modeling, and several grant programs, many of which relate to coastal resilience. Spend plans for the IIJA are currently under review by Congress. NOS anticipates receiving approximately $982 million over five years for some of their top priority work, including $150 million to enhance NOAA's observing systems. Through use of these funds, NOS and their NOAA partners look to transform water prediction by delivering the first ever coupled continental-scale operational coastal and inland flood forecasting and inundation mapping. For the FY23 President's Budget, NOAA received a pass-back from OMB in February and is currently looking to make adjustments to its budget and planned initiatives. Ms. LeBoeuf continues to serve as the NOAA representative on the interagency Committee on the Marine Transportation System (CMTS) and leverages this role to promote the inclusion of long-term resilience planning into MTS infrastructure needs. She looks forward to Admiral Ann Phillips' appointment to the Maritime Administration and chairmanship of the CMTS. NOAA's relationship with the Department of Transportation also continues to be important in the response to the President's push for whole-of-government approaches to the climate crisis. As NOAA continues to advocate for the traditional blue economy sectors, Ms. LeBoeuf will lead NOAA in supporting and promoting the NOAA Administrator's vision for the new blue economy. With blue economy activities writ large expected to double between 2010 and 2030, NOAA's role in providing data to ensure the success of these industries will become increasingly important.

Rear Admiral Benjamin Evans, Director, Office of Coast Survey, National Ocean Service, and HSRP Designated Federal Officer, said that NOAA's navigation services offices play a critical role in providing foundational data that helps address goals such as responsible economic development through the new blue economy, equitable service delivery, coastal resilience, conservation, infrastructure, and other areas where NOS priorities and HSRP interests overlap. NOAA staff is steadily working towards reintegration into the office environment as pandemic conditions improve, though they still continue doing most work remotely. RDML Evans recognized the NOAA team and their public and private sector partners who have worked tirelessly to ensure that the nation's hydrographic and navigation services have remained up and running during this time. RDML Evans welcomed the three new HSRP members and congratulated Julie Thomas and Sean Duffy who were reappointed for four-year terms. They are seeking new qualified members for upcoming HSRP vacancies in 2023 and 2024, and nominations are due April 15. RDML Evans reviewed the meeting agenda and commented that the number of HSRP issue papers to be discussed represents an especially high level of activity. He expressed his appreciation for the work and planning by the members and NOAA staff to jointly address the interests of the HSRP and NOAA's requests for advice. He thanked members of the public that provided comments in advance of the meeting and encouraged others to provide input during the meeting to be included in the public record.

Randy TeBeest, Deputy Assistant Administrator for Programs and Administration, NOAA Office of Marine Aviation Operations (OMAO), provided a high-level overview of NOAA's fleet modernization and recapitalization activities. OMAO provides ship, aircraft, and uncrewed platforms for the agency's observational missions. NOAA currently has 15 ships in its fleet in eight different classes, and these ships are about 28 years old on average. Two of NOAA's four nautical charting vessels are 55 years old, which is one of the reasons vessel recapitalization is so important. NOAA is working from and updating its 2016 Fleet Plan, which identified four new vessel classes they would target and emphasizes multi-mission use for vessels. Two Class A ships for oceanographic monitoring, research, and modeling (the *Oceanographer* and the *Discoverer*) are currently in the detailed design and construction phase. A draft request for proposal has received industry comments and is being prepared for solicitation for the acquisition of two to four Class B vessels for charting and surveying. NOAA currently has nine aircraft of four different types. Reducing the types and classes and focusing on multi-mission applications and more

standardized operations is the key to the recapitalization plan. A King Air 350 remote sensing aircraft was delivered in June 2021. A Gulfstream G550 high altitude jet is currently being modified for delivery in FY24. The Aircraft Recapitalization Plan will address the requirements for a second G550, four P3 replacements, a third King Air, and a fifth Twin Otter. Mr. TeBeest reviewed some of the activities of the UxS Operations Center (UxSOC), as well as some of their partnerships and collaborations. High priority projects underway at the UxSOC include advancing UAS-based topobathymetric mapping operations along river corridors to inform management of endangered Pacific salmon and studying the use of uncrewed surface vessels in tandem with NOAA vessels to increase survey efficiency.

HSRP Q&A

Dave Maune asked if NOAA is limited to having Uncrewed Aerial Vehicles (UAV) made entirely of components made in the U.S. Mr. TeBeest said there is a bill limiting the use of foreign-made and foreign-owned aircraft. He was not sure to what level it limited use of parts from outside of the U.S., but recommended the Director of UxSOC, Captain Phil Hall, speak to the HSRP on some of the more detailed operations and limitations.

Ed Saade asked for updates on over-the-horizon operations of surface vessels. He asked who would set those rules and if it seemed like regulations would be released in the near future. Mr. TeBeest expected that the Coast Guard would be involved in the rulemakings and NOAA will lean on UxSOC's recommendations. It will take time to get comfortable with beyond-line-of-sight operations and to get regulations for those activities.

Lindsay Gee asked for further details on requirements for mapping systems that meet the National Strategy for Ocean Mapping, Exploration, and Characterization (NOMEC) multi-mission requirements. He commented that telepresence should be standard on vessels and hoped that increased satellite connectivity will be part of the specifications going forward. There are a number of reasons this should be supported, including proving additional support and creating more opportunities for making voyages more equitable. Mr. TeBeest said that NOAA is building out its very-small-aperture terminal (VSAT) capability for the current fleet and posturing themselves for decades to come, though most of this comes down to affordability. Connectivity also adds to the crew's quality of life onboard and will be important for attracting and retaining workforce.

Nathan Wardwell asked if any of the forthcoming oceanographic vessels have ice-strengthened hulls. He added that the Uncrewed Surface Vehicles (USVs) being acquired are vessels that do not typically do work in Alaska. USVs are an excellent approach to addressing the mapping needs in Alaska. Mr. TeBeest said some level of ice operations were envisioned by the integrated project team that looked at the requirements and some ice-strengthening capabilities were built in.

Qassim Abdullah asked if satellite-derived bathymetry has been considered to fill some of the data gaps. Mr. TeBeest said he did not recall hearing much about satellite-derived bathymetry, but he was not a part of the project team that looked at this specific capability. He will have the team respond to the Panel with a more robust answer.

Updates: Opportunities, Challenges and Priorities for NOS' Navigation Services Portfolio

Rear Admiral Benjamin Evans, Director, Office of Coast Survey, National Ocean Service, and HSRP Designated Federal Officer, has emphasized three broad focus areas since coming into his role in December: completing the transition to being a data-focused organization, partnerships and relevance, and workforce development. The shift to being data-focused is critical to OCS remaining relevant, nimble, and successful. OCS' value to the nation lies in their integrated and world class understanding and abilities in hydrography, cartography, GIS, modeling, and the information and knowledge these

disciplines produce. OCS will continue to deliver on its core mission of supporting safe navigation and nautical charts while also providing a wider range of products and services to an expanding customer base. OCS must continue to increase their relevance and capacity through partnerships. To meet its goals, they must continue to build, sustain, and lead relationships across NOAA and with other federal, academic, and private partners. Working together, they will be better positioned to secure resources and innovate more efficient techniques to build capacity for the future. NOS and OCS, like the rest of NOAA, must sustain and build their workforce. This will mean stepping up succession planning and preparing for the upcoming generational shift in their workforce in a way that expands their talent pool. In this effort, it is important to emphasize the principles of respect and inclusion. OCS anticipated FY22 would be a challenging year for their budget. They are still digesting the appropriation that was just passed; if any additional funds are available, OCS will be prepared to act on them quickly. OCS has been very involved with the IIJA Provision 3, which focuses on flood and inundation mapping, forecasting, modeling, and precipitation studies. In cooperation with NGS, OCS plans to collect and integrate high resolution bathymetric and topographic data to advance these capabilities. Working with CO-OPS, OCS plans to expand geographic coverage of their coastal models and interface with NOAA's Land-Water Model. OCS also plans to work with the National Hurricane Center to enhance storm surge capabilities during extreme weather events. OCS is awaiting news about the FY23 budget and will begin planning for FY24. The NOAA Custom Chart tool will support printable raster-like products from their electronic navigational chart (ENC) data. OCS expects to rely heavily on private sector partners to identify and meet demand for these products. The new subversion 1.3 will be released in the near future with version 2.0 to follow, which will add capability for users to create accounts and save the charts they create. OCS is working to accelerate re-scheming of their ENC suite, which will improve the charts and the functionality of the Custom Chart tool. With increased collaboration and data sharing, OCS is seeing a dramatic increase in the amount of bathymetric data they are ingesting and expect that those volumes are only going to increase. Their current data infrastructure and protocols must be made more efficient, particularly at the data hand-off points. Data licensing can help achieve this by making data throughput faster and scalable while also reducing bookkeeping and reducing the risk of errors or mishandling. The National Bathymetric Source (NBS) was designed from its inception to accommodate data licenses. OCS is in the process of building out the NBS, which supports three product pipelines: navigation (ENC and S-102), internal (Hydrographic Survey Division planning), and public (BlueTopo and Coast Survey Development Laboratory modelers). The BlueTopo product is part of NOAA's Big Data Program and has been used to create a regional seascape map for New England to show how the seafloor components and habitats across the region are distributed and will support numerous ocean-related products in the Gulf of Maine. OCS is working on developing additional products for dissemination through their precision marine navigation portal. Their focus this year is to develop prototypes in the S-102 format (high resolution bathymetry) and S-104 water level information. RDML Evans took the chair of the NOMEC this year. Public engagement and partnership building activities are underway and OCS has successfully completed a pilot project on the Blake Plateau, which included several partners focusing on mapping and exploration. OCS is currently in the process of identifying 2022 flagship projects. OCS has just released its report entitled *Mapping the Gaps*, which indicates where they stand with respect to the NOMEC goals. They have increased the area mapped under NOMEC by 1%, bringing the total of unmapped U.S. coastal, ocean, and Great Lakes waters down to 52%.

Juliana Blackwell, Director, National Geodetic Survey (NGS), NOS, NOAA, provided an update on NGS' activities, highlighting base budget program activities that could be enhanced by supplemental funding in support of the administration's priorities. NGS is poised to provide additional coastal mapping work in the areas of shoreline imagery and topobathymetric lidar surveys that would support their own work as well as National Weather Service's National Water Center efforts. NGS would also be able to provide additional funding for their airborne gravity collection as part of the NSRS modernization effort. NGS is looking into how they could provide more support for the measurement of vertical land motion and integrate land motion into their data and inundation projects. Ms. Blackwell provided an overview of

the planned work for NGS' Coastal Mapping Program in FY22, focusing on their photogrammetry and topobathymetric lidar operations. Despite the pandemic, NGS has made progress in its Gravity for the Redefinition of the American Vertical Datum (GRAV-D) project and has now collected airborne gravity for 92.25% of the U.S. The work to build out the Foundation CORS (Continually Operating Reference Stations) subset of the CORS network continues. NGS is co-locating many geodetic techniques and upgrading stations to bring them up to international standards so they can be incorporated into the international network of geodetic stations. Two new Foundation CORS installations are planned for FY22 and six more sites are targeted for future installations. NGS' Online Positioning User Service (OPUS) was been upgraded to OPUS Projects version 4.0, which enables users to Bluebook their GPS projects. A beta version of OPUS Projects 5.0 is now available for testing. This version allows users to add RTK and RTN observations to their Bluebook projects using the new GVX vector exchange file format. The GPS on Bench Marks campaign has been very successful in crowdsourcing GPS data to help NGS build better products and tools. NGS is actively seeking input from customers and stakeholders on the products they provide and those they are developing for the modernized NSRS.

Richard Edwing, Director, Center for Operational Oceanographic Products and Services (CO-OPS), NOS, NOAA, provided an update on CO-OPS' recent activities. CO-OPS completed the Delaware Bay tidal current survey in November 2021, updating predictions at 35 locations as well as collecting conductivity, temperature, and density data. CO-OPS has begun a two-year survey of the Columbia River, which was prompted by the deepening of the channel to allow larger ships to reach the ports of Portland and Vancouver. CO-OPS has completed its recapitalization of the Dauphin Island National Water Level Observation Network (NWLON) station. After COVID delays, a new structure was recently completed and instrumentation installed and it will be provisionally operational after data QA/QC and internal reviews are completed. In addition to several enhancements, this year CO-OPS is installing new PORTS at Kitsap Peninsula, Washington, and Freeport, Texas, and Pearl Harbor, Hawaii, and Brownsville, Texas, in FY23. The Mobile Bay Marine Channel Forecast is a decision support tool that integrates critical oceanographic and meteorological forecasts. Vessel operators can now use it to view all NOS water level and tidal current forecasts alongside NWS weather forecasts for winds, wind gusts, rain chance, and marine hazard alerts in Mobile Bay. This tool addresses the HSRP's recommendation to improve visibility observations and forecasts. CO-OPS' Coastal Inundation Dashboard (CID) has been enhanced to include extratropical storms. Additional enhancements to the CID will include integrating CO-OPS' high tide and sea level products. CO-OPS data was integral in the preparation of the *2022 Sea Level Rise Technical Report* and they have been creating Applied Programming Interfaces to make accessing their data easier for users looking to do their own analysis or develop their own tools to prepare for sea level rise. Mr. Edwing presented observed water levels following the Tonga volcanic eruption to highlight the contribution CO-OPS makes to the Tsunami Warning System. This information is illustrative of the value of observing systems to improving our understanding of the entire earth system.

Captain (NOAA, ret.) Andy Armstrong, Co-Director, NOAA-UNH Joint Hydrographic Center (JHC), University of New Hampshire (UNH), provided an update on activities at the JHC. The JHC is partnered with the Ocean Exploration Trust in mapping and exploration under NOMEC, and they will be evaluating the Ocean Exploration Cooperative Institute's DriX USV for coastal water bathymetric survey work in the Papahanaumokuakea National Marine Sanctuary. This mapping project will also be in collaboration with NGS' Remote Sensing Division's topobathymetric lidar collection and will employ the multisensor shallow water bathymetry approach the HSRP has previously discussed. Captain Armstrong hopes to be able to report on the project at the Panel's fall meeting. The JHC's work has three major themes: advancing technology to map the U.S. waters, advancing technology for digital navigation services, and developing and advancing marine geospatial and soundscape expertise. Captain Armstrong played a video focusing on the JHC's research into how augmented reality technology can be used to increase safety of navigation. Augmented reality overlays have proven very effective at presenting navigational waypoints while keeping mariners' eyes on the water. In the absence of overlays,

participants in JHC studies looked at their ECDIS map more than twice as often and took their eyes off the water for over twice as long. Field of view did not have an effect on this. Even restricted field of view augmented reality devices can greatly increase marine navigation safety. JHC is now moving beyond simulating augmented and virtual reality to create a true augmented reality prototype that can be used in the lab and on the JHC's boat. The video presented many of the ways that digitizing nautical textual information can add value to and increase the capabilities of the Chart of the Future. This video is available at https://www.nauticalcharts.noaa.gov/hsrp/meetings/2022/spring/presentations/02+Directors+Updates/04+CCOM-JHC-HSRP-March-2022.mp4 and https://www.youtube.com/watch?v=pxxP1W1qImE.

HSRP Q&A

Qassim Abdullah asked whether NOAA actively supports crowdsourced bathymetry by the community of practice in local geographic areas of interest. RDML Evans said NOAA has created the Brennan Matching Fund as a way to work with state and local government entities to leverage combinations of funds to work on mapping priorities. OCS has extensively looked into utilizing crowdsourced bathymetry from mariners and remains engaged with this community. The National Centers for Environmental Information (NCEI) manages an archive and a process for ingesting crowdsourced data.

Lindsay Gee asked if NGS' Remote Sensing Division coordinates with the U.S. Geological Survey (USGS) on lidar coverage, specifically around the Pacific. Ms. Blackwell said they have very good coordination with USGS and strive to support each other's collection efforts, especially along the coasts. NGS also has a lot of coordination with the U.S. Army Corps of Engineers through the use of the SeaSketch tool. Mike Aslaksen added that the Remote Sensing Division strives to collect the entire area in its work in the Pacific, whether they are doing topobathy or topographic lidar. They also look for overlap in the contiguous U.S. in order to acquire a topographic collection that ties into the topobathy collection seamlessly.

Nathan Wardwell said he is excited to be able to do Bluebooking directly out of OPUS Projects, as this will make the process much more efficient. Integrating the use of RTX and RTN with OPUS processing is also exciting. The State of Alaska is building out an RTN network, as is the National Park Service in the state, which will help with leveraging positioning statewide.

Mind the Gap: Plans for Data Licensing and Big Data Ingestion/Use for Charting and Bathymetry Products

Deanne Hargrave, HSRP Member and Geoscience Manager, Atlantic Shores Offshore Wind LLC, and Commander Briana Hillstrom, Chief, Hydrographic Surveys Division (HSD), OCS, NOS, NOAA, moderated the session focusing on how data licensing will help NOAA achieve its national mapping goals. The session focused on data needs and opportunities to facilitate the sharing, collaboration, and throughput of bathymetric data. Attendees gained a perspective on the future of data sharing and how to unlock the full value of data for applications beneficial to the blue economy and supporting climate change adaptation.

Tony LaVoi, Chief Data Officer, NOAA, presented an overview of NOAA's approach to develop and publish NOAA Data Licensing Guidance that conforms with and supports requirements from the Foundations for Evidence-Based Policymaking Act (Evidence Act) and NOAA Data Strategy goals. Equitable and open access to their data, information, and services drives NOAA's mission and underpins the administration's highest priorities for the agency. Phase II of the Evidence Act includes specific actions that agencies are expected to take regarding open access and management, including making public data assets available under an open license. In 2020, NOAA created the first NOAA Data Strategy focusing on maximizing the value of their data. This strategy included five goals: (1) Align data

management roles across the organization; (2) Govern and manage data strategically to most effectively steward the U.S. taxpayers' investment; (3) Share data as openly and widely as possible to promote maximum utilization of NOAA data; (4) Promote data innovation and quality improvements to facilitate science and support data-driven decision-making; and (5) Engage stakeholders and leverage partnerships to maximize the value of NOAA data to the nation. An action plan is currently in the final stages of approval which lays out 23 specific actions and 70 milestones and deliverables. Data governance improves decision-making and provides a foundation for communication and collaboration across disparate systems and processes. NOAA's implementation of data governance includes standing up a Data Licensing Task Team under the NOAA Data Governance Committee, establishing the position of Assistant Chief Data Officer, and creating a Data Policy Framework. Mr. LaVoi reviewed the NOAA Draft Strategic Plan's proposed actions and discussed how they correlate to the Evidence Act requirements. There is a longstanding and pressing need to address data licensing needs and opportunities within NOAA. NOAA is looking at this from the perspectives of being both a data provider and a data user. An internal task team has been established to begin addressing immediate needs. The long-term open data goal is to establish an overall NOAA data licensing approach with the ultimate aim of creating a series of data licensing policies and guidance documentation.

Matt Wilson, Physical Scientist, HSD, OCS, NOS, NOAA, presented on OCS' implementation of bathymetric data licensing, why they need data licensing, and how will it be implemented. Open bathymetry is as open, accessible, and usable as possible and must conform to the Evidence Act requirements. This includes all the data NOAA acquires in-house and through contracts, as well as much of the external data OCS ingests. The application of an open data license eliminates ambiguity by removing copyright and giving all users the assurance they need to freely use the data. OCS increasingly relies on external data, which is critical for meeting national and global mapping objectives. NOAA needs to know who this data belongs to and what it can be used for, which takes time to resolve and the answers they get are not always clear. Very few collectors of data have data sharing agreements in place with NOAA. NOAA also needs to know if they can share the data, make it publicly available, make products from the data, and if third parties can use it. The application of a data license answers all these questions. Mr. Wilson described the process for how data licensing works. The recommendations in favor of data licensing are clear and so the question becomes: which data licenses should NOAA adopt? Creative Commons licenses have been proposed for many reasons, including that they are well-known and internationally recognized, they have been recommended for U.S. government data, and they accommodate external data scenarios. NOAA has a custom-made internal-use-only license that will apply to any sensitive data they might receive.

Dr. Brian Calder, Research Professor and Associate Director, Center for Coastal and Ocean Mapping (CCOM) and NOAA-UNH Joint Hydrographic Center, University of New Hampshire, presented on how to normalize the selection and acceptance of data licenses for bathymetric data. He discussed data licensing from an academic perspective, particularly focusing on how to go about the socialization piece. Academics and other providers do not necessarily want to be involved in anything other than scientific endeavors, so they need to be convinced why data licensing should become a normal piece of this process. Dr. Calder related a story about CCOM being contacted by Google, who wanted to use their data. When asked about their data licensing, they ended up providing Google with an agreement that unintentionally made it more difficult for them to use their data. The researchers needed a clear list of what they should be asking their attorneys and data officers to prepare, which would include: clear communication of allowed uses to the end user with minimum ambiguity, well-known agreement terms that have already been analyzed and pre-approved, a machine-readable description of license, and data-encoded license terms to travel with data products. CCOM data that goes out now includes language that the work is licensed under the Creative Commons CC0 license, which makes it much more valuable for their colleagues to use. Several things became apparent from this experience, including the need for increased awareness that data licensing is something NOAA should be considering, the need for a

standard license that NOAA prefers and can recommend, the need to make it as easy as possible for people to apply a data license, and that NOAA could include data licenses as an award condition, making the data license part of the data management protocol.

Dr. Kurt Schwehr, Software Engineer, Google, and Affiliate Research Professor, CCOM, University of New Hampshire, presented a description of the key aspects around managing data ingestion and using greater than 50 petabytes (PB) of spatial data. Dr. Schwehr provided an overview of his background before coming to Google as a software engineer working on Google Earth Engine. Google Earth Engine is ten years old and is dealing with how to manage data at scale across huge numbers of users and datasets. As an example, he walked through the process of a user looking to use the CCOM Law of the Sea data and demonstrated some of the difficulties users may experience. Google Earth has been able to establish a memorandum of understanding with CCOM to use their data, but it took over six months. Better alternatives for doing this include SPDX (Software Package Data Exchange) and STAC (SpatioTemporal Asset Catalogs) for cataloging and tracking licenses that go with data. SPDX is an open standard software bill of materials used for data. The SPDX catalogue includes more than 100 licenses and offers some general guidance. The value of SPDX is that no license analysis is required if you have pre-approval. Processes that were previously taking several months turn out to take only a few seconds. STAC attempts to capture the lifespan of data as it is used in different applications and derived products, so that programmers and users of data can manipulate it easily and ask questions of the data without requiring much work. STAC is supported by an active community of developers with involvement from a large range of organizations coming together to make data processing easy and make licensing just a part of the ecosystem.

Commenters

Lindsay Gee, HSRP Member and Mapping and Science Coordinator, Ocean Exploration Trust, was very supportive of data licensing as a way to make data accessible and useful. NOAA's data represents a national investment. Data licensing should also facilitate others contributing and should not be seen as an additional overhead cost. It should make things easy and encourage people to contribute. There is also an opportunity for industry engagement, and the HSRP should encourage NOAA to engage with software producers to be able to have licenses inserted at source. This would lower the barrier for people contributing the data and make it easier and more available for end users. A key part of this will be NOAA's outreach in conveying these stories that show it is not difficult to implement.

Guy Noll, Associate Director, Esri Mapping Systems, said that even though these conversations can seem esoteric to some, it is incredibly important and has received much more attention over the last decade. Esri has made their Living Atlas an alternative source for public data under the FAIR (findable, accessible, interoperable, reusable) principles. This licensing structure allows Esri to maintain a secondary source for users in the event that NOAA's data is unavailable due to government shutdowns, as has caused problems in the past for state and local governments. When Esri decided to release ENCs for free, that content became a source for many kinds of innovation still being realized today. Having an easy-to-use licensing structure will improve the ability to create innovative solutions.

Ed Saade, HSRP Member and Group Director Americas, President USA, Fugro Inc. (ret.), said that, while getting into the details of data licenses can be intimidating, there are many companies that want to donate data. This is especially true as more corporations seek to demonstrate sustainability goals, which could include donating data and the concept of "map once, use many times." The real objective is to make it as easy as possible for everyone to begin to do. NOAA needs to find a way to collect the data, process it, and let people use it for their purposes, even if it is not up to the highest standards of accuracy.

Derek Hanson, Attorney-Advisor, Weather, Satellites, & Research Section, NOAA Office of General Counsel, said that data licensing should come to be seen as routine, with the tools available to

do it. He has spent many months, and even over a year in some cases, trying to negotiate access to someone else's data and trying to ensure commercial users that they can use NOAA data without restriction. Everyone agrees that NOAA's data should be fully open; it's just a matter of documenting it. The proposed tools are a great path forward and the lessons learned from OCS could be applied NOAA-wide.

HSRP Q&A

Qassim Abdullah said it is impressive to see where NOAA is going with their data policy. It would be nice if there was a direction to provide information on accuracy in the metadata.

Lindsay Gee asked if there is a way NOAA could show where data is available without presenting the data itself if it is not deemed to meet their specifications. If NOAA can provide that and the owner of the source data, it would allow the parties to negotiate it separately. Mr. Wilson said that they get questions about available data all the time and if the data had a license on it they would already have the answer. Once organizations start coalescing around one of the well-understood license types then it becomes much easier to share data.

Deanne Hargrave asked how NOAA envisions reaching out to private industry on its data licensing objectives. Mr. Wilson said this is part of the plan and for people not used to talking about licensing it seems daunting, but the point of the license is to remove the extra work and expedite things. The outreach will be ongoing and it will get better once this becomes more ubiquitous throughout the industry. Dr. Calder said the requirement has become routine and, even though it is not hard, scientists will not do it until they are told to. NOAA needs to provide the support and education and it will be accepted.

Andy Armstrong asked if the downstream products that leverage NOAA or UNH data carry the restrictions with them that was embedded in the original data. Mr. Wilson said only if the data has a Share-Alike requirement would they have to maintain the license, in which case it could not be used for charting. Mr. Saade noted that the definition of "commercial" could possibly be very broad.

Public Comment

Lynne Mersfelder-Lewis read the following comments received during the first day of the meeting:

Mark Luther, Professor, University of South Florida College of Marine Science: Can Infrastructure bill funds be used to expand/fund NOAA PORTS operations/maintenance? Mr. Edwing said no, because within the coastal inundation and flood mapping and the ocean coastal observing system sections, PORTS did not meet the criteria. IIJA is a five-year bill and then the funding ends, so projects requiring long-term maintenance do not fit very well. There are several federal agencies that got money that may be going out in grants, such as the Department of Transportation, who may issue grants to establish or expand a PORTS. Money for maintenance would probably not be appropriate through one of those grants though.

Charlene Sylvester, Research Physical Scientist, USACE: Hoping to learn that the data licensing will not hamper federal coordination efforts.

Jason Sjolander, Product Development Manager-Maritime, East View Geospatial: Please make the NOAA Custom Chart tool export extents adhere/be able to accept the chart equivalent extents.

Houssem Sadki, TTSM, Hydrographic Data Manager and Survey Party Chief, Dakar: [Improve] web services and APIs.

Evan Martzial, VP Business Development, Terradepth: Make data more accessible to more people.

Bob Moshiri, Business Development Manager, Johnson Outdoors: More near shore bathymetric surveys for safety of navigation and environment (recreational anglers driving direct to hotspots).

John Schneider, Marine Operations Supervisor, Marathon Petroleum: Keep improving electronic charts for use with EDCIS systems.

Matt Holland, Sales Manager Americas, XOCEAN: Does NOAA have targets to increase the use of USVs for data collection to improve safety and lower environmental impact?

Paul Devine, Technical Sales Manager, Teledyne: I am interested in how we can better facilitate the collection of oceanographic and hydrographic data on autonomous platforms.

Praveen Vamadevan, Proposal Manager, Fugro: Fugro can provide reliable geo-data effectively and to the highest standards, contributing to safe navigation & development.

Denis Hains, h2i.ca: Thank you for great opening remarks by Assistant Administrator for NOS-NOAA Ms. LeBoeuf and RDML Evans. It is great to see that all vessels class beside Class B are all charting and surveying as secondary mission. And the same for airborne and uncrewed platforms. This is a great plan. He asked Randy TeBeest: Acknowledging that these recapitalization assets are first and foremost for the US priorities, to what extent are you open to share your plans and resources with neighbor countries where US share an international boundary with, including the Arctic and the Great Lakes? What about satellite-based data platforms, are they part of the plan or on a separate plan?

Denis Hains, h2i.ca: For the information of all the HSRP participants - Thank you to Lynne Mersfelder-Lewis, Dr. Qassim Abdullah, Ed Saade, and Julie Thomas for a note on HSRP published in the Vol. 26 of the International Hydrographic Review last November 2021. The note is at: *https://ihr.iho.int/articles/a-commitment-to-engage-and-involve-stakeholders-the-experience-of-the-united-states-of-americas-hydrographic-services-review-panel-federal-advisory-committee/*

Briana Sullivan, UNH CCOM: A question for RDML Evan: With the focus on being data-centric (especially with the great progress being made with the S-100 products) it seems appropriate to restructure the nautical publications branch to follow suit. Are there any plans to restructure it? I'm talking specifically to convert book managers for the 9 books of the coast pilot into data managers for expertise in specific data layers that supplement the chart. RDML Evans said OCS sees tremendous opportunity for improvement here. The challenge they face is that it is a matter of resources and priorities. They are making incremental gains on the Coast Pilot and have ideas for a wholesale reimagining of it. Maintaining the current product and developing a new one simultaneously is resource-intensive.

Jon Dasler, David Evans and Associates: Exciting use of the color laser scan data on the Mississippi River. Great job!

Denis Hains: Question for Matt Wilson: By external data, do you mean including crowdsourced bathymetry and trusted crowdsourced bathymetry nodes? Is data licensing implemented to cover potential liabilities or for data quality assurance?

Guy Noll: Per my comments - https://www.go-fair.org/fair-principles and https://livingatlas.arcgis.com/esri_ngda_datasets/#:~:text=Today%2C%20Esri%20is%20making%20this%20collection%20of%20geospatial,in%20ArcGIS%20Online%20called%20the%20Esri%20Federal%20Datasets.

Starla Robinson: In addition to bathymetry, surveys often have ancillary image data of features and substrates. Is there any value in making those images more discoverable for the public? (I believe this is

an issue of the cost of data storage and maintenance, but perhaps asking the question to the larger community could generate an opportunity.)

Michael Michalski: Per Dave Maune comment on needing to expand VDatum in Alaska: Currently the VDatum program is working to obtain additional water level datums and ties to the geodetics to be able to fill the data gaps to enhance and expand the grid transformations.

Starla Robinson: Comment for Deanne Hargrave and Kurt Schewhr: In regards to augmented reality and virtual reality, I like to visit my hydrographic projects in VR Google Earth as I plan them. I imagine the value would apply to any planner, including wind farms. 3D evaluation can really add to my understanding of an area.

Day 1 Meeting Recap and Round Robin with HSRP Members and NOAA Leadership

HSRP members provided final comments on the meeting, including: it was great to hear about Tribal engagement on NBS and Native corporations should be engaged when considering public-private partnerships to address coastal mapping needs in Alaska; pleased to hear about updates to OPUS; members would like a briefing on the *2022 Sea Level Rise Technical Report*; pleased to hear about relationships with the Department of Transportation; topobathymetric modeling was good to hear about, as it is very beneficial for pre- and post-storm and resiliency programs in coastal states; remote operations can offer diversity, equity, and inclusion opportunities; members would like to see more examples of the data and the latest that people are capable of delivering; members appreciated the opening remarks, especially the fleet modernization and recapitalization update; members appreciated bringing the lens of diversity, equity, and inclusion to the issues before them; CO-OPS' work on the Columbia River is much needed; augmented reality navigation seems like a step in the right direction to get mariners looking out of their windows more; the importance of expanding VDatum in Alaska; there was interest in anything concerning accuracy reporting as part of the data licensing discussion; all fleets need to access basic navigation products and NOAA must understand the needs and capabilities of the end user capabilities; NOAA needs to consider uneven digital communication in remote areas and the extent to which this creates problems for the mariner; members hoped that more topography will be incorporated into the NOAA Custom Chart tool; BlueTopo is a very promising tool; the possibility of augmented reality as a tool for attracting the next generation of hydrographers; remote operations should be part of the IT infrastructure of every surveying vessel; OMAO should be engaging with industry on uncrewed systems, especially small businesses; NOAA should be looking at data as a service and questioning if they really need the systems in-house; excited to continue the coastal resilience conversation and all of the ways NOAA can and does contribute; with changes to the supply chain expected, there will be a lot of first-time callers coming to U.S. ports and there needs to be a lot of socialization of NOAA's information; the possibilities of utilizing augmented reality applications during restricted visibility conditions should be explored; NOAA should explore how BlueTopo can be integrated into USGS' 3DEP database for seamless transition from topography to topobathy. Mr. Edwing said he is interested in following up on how data licenses in their offices might improve things and if they are fully covered for the data they have been ingesting. Ms. Blackwell responded to earlier comments on work all three offices are doing collectively to update VDatum for Alaska, which should be complete by 2026. NGS is not hosting a Geospatial Summit this year but will be providing updates through webinars. Office Directors were eager to learn more about digital twins and how they could be put to use in their work. Captain Armstrong thanked Panel members for their feedback on the augmented reality work at JHC. RDML Evans was very impressed with his first HSRP meeting as DFO. Incentivizing and supporting participation in data licensing could lead to real benefits, particularly under NOMEC. More community and industry outreach are clearly needed. He was also pleased to see how augmented reality techniques can encourage mariners to look out the window.

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Thursday, March 10, 2022

Round Robin recap from Day 1 and continued HSRP discussion

HSRP members shared additional thoughts on the previous day, including: the promise of digital twins, especially when virtual reality is incorporated, in improving navigation; members thanked NOS leadership for their engagement with their own organizations; members would like to hear more about how NOAA can streamline implementation of data licensing; the HSRP should be kept apprised of the NOS' Strategy Paper once it is available; many different topics that have been discussed feed into BlueTopo, such as data licensing and interagency coordination; mapping in less than 40 meters of water may be a timely topic for the fall meeting as many upcoming infrastructure projects will be in shallower water and it ties into coastal resilience; the transition from raster to ENC is a very important issue and NOAA needs to handle it appropriately; members were eager to see how improvements to the NOAA Custom Chart tool can benefit smaller vessels; members were interested to see how BlueTopo will fit in with the 3D National Elevation Requirements and Benefits Study; the lenses that agencies bring to mapping of flood risks for flood probabilities maps can end up leading to maps that look very different from each other and the HSRP may want to think about interagency coordination that would enable building a framework for which map to use for what purpose; members suggested adding diversity, equity, and inclusion to the priorities matrix; HSRP staff providing the public comments in advance and keeping them coming in in real time during the meeting is helpful; the HSRP should be advocating for metrics on diversity, equity, and inclusion, as well as NOAA's sustainability goals; the topic of public-private partnerships opens up possibilities for working with other advisory committees; it is apparent that moving forward on the topic of data licenses will be important not just for OCS but in moving NOMEC forward and making it more valuable. Ms. Blackwell offered a brief update on the OPUS 5.0 questions raised on the previous day. NGS is hoping to have a version of OPUS 5 out into production by the end of the calendar year. They need more testers to provide feedback on the beta version available on NGS' website. Mr. Edwing said that datums will need to be better understood and resolved in order to realize all the benefits of the augmented reality and virtual reality technologies being developed.

Bridge Heights and Datums: What's NSRS, Air Gaps, and Navigation Have to do With It?

Sean Duffy, HSRP Member, Galen Scott, Constituent Resources Manager, NGS, and Chris DiVeglio, Maritime Services Program Manager, NOAA PORTS Program, CO-OPS, moderated the panel focused on how new technology can work with datums, bathymetric surveys, positioning, and air gap sensors to promote the blue economy. The panel explored the technological possibilities of using data from the modernization of the NSRS to harmonize the myriad of datums at the coast and meet the requirements for measuring accurate heights to determine bridge clearances for safe navigation. Examples of challenges along the Mississippi and Lower Columbia Rivers were highlighted.

Julia Powell, Chief, Navigation Services Division, OCS, NOS, NOAA, presented on the importance of common datums for navigation. The primary navigation system for SOLAS class vessels, ECDIS, is currently S-57 based, which is a single product system where all the data is contained within the S-57 ENC. It cannot be adjusted for water levels or incorporate different types of surface currents, and adding high definition bathymetry greatly enlarges the file size. OCS is looking at building on the S-100-based ECDIS, which is a multiple product system that can be used with little to no integration, and different layers can integrate with each other. In the future, they will also include weather overlays as part of an integrated navigation package. Safe marine navigation requires sufficient horizontal and vertical information and currently the chart only provides a static snapshot of only some of this information. The mariner must use the chart along with other data sources to gauge route safety. Water levels change over

time and so charts have multiple vertical datums that capture the extremes of temporal variation of water level. These allow for a minimum safe under keel clearance and vertical clearance to be shown, but the charted depth shows a simplified minimum depth, and the charted vertical clearance shows the minimum space above the water of a feature. Even within the U.S., the two datums are not always aligned in mean lower low water or mean high water, but they are normally a low water for depth and a high water for clearance. S-100 will allow data producers to reduce the amount of manual work necessary to understand whether a planned navigation is safe with respect to depth. ENC plus dense bathymetry (S-102) and water level (S-104) gives the fundamental "depth" against which under keel clearance and vertical clearance is measured. Being able to navigate with S-100 will eliminate the barrier to being able to adjust water levels against bathymetry data. Integrating S-101, S-102, and S-104 is a complex process that only works if S-102 depth values can be substituted for the underlying S-101 depth data and S-104 water levels can be added. The only way this can work is if the vertical datums of the products are exactly the same. This is a worldwide problem that the International Hydrographic Organization (IHO) has been working to resolve by developing international standards. The S-100 Framework has incorporated water level adjustments to bathymetry for use in navigation systems. NOAA has specified that datums must be the same across the product stack and that this must be done by the producer of the product. Navigation systems are not equipped to perform complex datum transformations and producers do not want to assume the liability.

Sean M. Duffy, Sr., HSRP Co-Chair and Executive Director, Big River Coalition, presented on the invisible infrastructure important to the Mississippi River, the complexities of properly calculating the vertical clearance of the seven bridges that transit over the Mississippi River Ship Channel, and the need for increased channel adjusted data and metrics. Mr. Duffy discussed the National Transportation Safety Board's (NTSB) findings following a bridge allision on the Lower Mississippi. It was later revealed just how lucky it was that the bridge did not collapse following the strike. NTSB's accident brief stated that "navigation aids should provide mariners with a simple and precise way to navigate and not increase workload or cause confusion." The NOAA air gap system is a tool that measures the vertical clearance between a defined reference point under a bridge and the surface of the water below. Losing access to the Mississippi River for a couple of days due to an incident comes at a very large cost to the national and local economies. Mr. Duffy discussed some of the challenges of vertical clearance for the bridges over the Mississippi River Ship Channel. One issue is that different organizations and federal agencies list the vertical clearance in different ways; in one instance, two agencies referenced an incorrect gage, which has since been corrected. Fortunately, the pilots were implementing things correctly so the ships transiting this area that would have air draft issues were properly accounting for air gap clearance. As a result of its investigation, the NTSB recommended that NOAA review and update bridge data and charts to include vertical clearance information for all navigable bridge spans. Pipelines are also a major issue as it is very difficult to identify how deep they are below the hard sand. This has impacted the Mississippi River Ship Channel deepening project, which is a project of national significance. Members of Congress are looking into pipeline safety following a recent rupture off the California coast. Mr. Duffy discussed some of the new technologies being employed to identify the depth of pipelines below ship channels.

Captain Paul Amos, Pilot, Columbia River Pilots, presented on navigation challenges and considerations along the Lower Columbia River. Along the Columbia River, it is 106 miles from the sea to the uppermost point of deep draft navigation at Vancouver, Washington, and another 12 miles up the Willamette River to Portland, Oregon. The channel is 600 feet wide and authorized up to 43 feet deep. Deeply loaded vessels use all available channel depth, arriving and departing on tide, working with minimum under keel clearance of two feet. Inbound vessels can ride up on one tide, but downbound vessels pass through three tidal changes, so it is important to know where they are going to find low water along the river. For route planning, the Columbia Bar Pilots rely on Loadmax, which predicts river levels at seven locations several days in advance. With this information, pilots can determine where they will have the least available under keel clearance and establish the best arrival/departure times for loaded vessels. More sensors are needed along the river and the pilots are working to get those. If pilots cannot

be reasonably certain that they will have at least two feet of under keel clearance, they are forced to implement draft restrictions. This can be devastating to the regional economy and is very costly to carriers and shippers. In addition to under keel clearance, river levels also present challenges with respect to overhead clearances. As cruise ships and container ships that call on the Columbia have grown much larger, the clearance on some bridges has been reduced to just a few feet. They have discovered that determining the available air gap is nearly impossible because there are too many different sets of data points, true clearances cannot be found easily, and when done correctly is very expensive. Captain Amos discussed some of his experiences with close calls on ships passing under bridges. The best solution for bridge clearances would be to install real time air gaps sensors. He discussed some examples of data confusion along the Columbia with different bridges providing sounding and clearance data in different chart datums. Bridges need to be more accurately surveyed to get better information for exactly what the clearances are. Around Longview, Washington, is where they have noticed the widest discrepancies in river levels and where improved accuracy is needed for the safe navigation of larger ships. Pilots would like to know whose information is on the charts and who has the authority to update it. The Columbia River Pilots received a $1 million grant to do a dynamic under keel clearance study, but to conduct the study, needed to find "zero" gauge. Since most, if not all, of the funding would be needed to find "zero" and that was not the stated purpose of the grant, they had to forfeit the money. "Zero" needs to be the same point for everyone. Mariners, ports, shippers and carriers need easily accessible, reliable information.

Chris DiVeglio, Maritime Services Program Manager, NOAA PORTS Program, CO-OPS, NOS, NOAA, presented on how NOAA effectively conveys air gap data and the importance of standardizing and communicating system setups. Air gaps sensors are a desirable tool, but just one of many in the toolbox to address the larger issues being discussed. Real time observations from PORTS sensors include water levels, currents, winds, temperature, visibility, salinity, and bridge air gap. The systems are tailored to meet the needs of local mariners. PORTS air gap data are collected at a high frequency interval and updated for the public every six minutes to account for changes in water level, vehicular loads on the bridge, air temperature, and other factors. This information is critical for pilots to safely navigate a ship under a bridge, especially as U.S. seaports grow and vessels continue to increase in size. There are currently 19 locations with PORTS air gap sensors, with two more in the works and additional areas of interest. Technology for collecting air gap data has changed over the years. Currently, the systems use a combination of radar and laser technology. Traditionally, CO-OPS utilized a single data collection platform for deploying the sensors but are now employing similar microwave radar technology used for water level. The overall cost of an air gap system is now much less than it used to be. Mr. DiVeglio discussed the quality control, visualization, and dissemination of the air gap data. Challenges in conveying air gap specifics include that every bridge design and waterway is different, there is limited widespread understanding of bridge specifics, there are different interpretations of "low steel" on specific bridges, waterways reference different datums, there is a desire to determine air gaps manually, and in most cases the bridge owner is different than the air gap sponsor. Real time air gap measurement on the PORTS webpage will vary from the fixed vertical bridge clearance value displayed on the associated NOAA nautical chart, which can lead to confusion. Also, the point on the bridge designated as the air gap reference point is not necessarily directly below the air gap sensor. Pilot groups often implement their own business rules or buffers when integrating air gap data into their toolkits. Taking all of the considerations in mind, CO-OPS needs to be sure they are strictly conveying what data they are disseminating and what is being referenced. In 2019, they began an initiative to standardize how air gap information is shared with the wider maritime community and ensure that all users understand the parameters. Letters are now on file for all operational air gap systems in a consistent format which highlight exactly where air gap equipment is located on the bridge, define each bridge's relation to navigation channel, where equipment is located in relation to the air gap reference point, precise leveling and measurement procedures, as well as station photos, diagrams, and schematics. These letters are distributed broadly to a wide range of maritime stakeholders. CO-OPS is changing standards going

forward to enhance their data reliability. The new standard will involve two data collection platforms with independent sensors and communications and they have offered partners with legacy systems the opportunity to upgrade to the new setup.

Jeff Jalbrzikowski, P.S., GISP, Regional Geodetic Advisor, NGS, NOS, NOAA, presented on the role of the modernized NSRS in navigation data harmonization, focusing his remarks on the vertical aspect of the NSRS, which is currently NAVD 88, but is soon to be the North American Pacific Geopotential Datum of 2022 (NAPGD2022). Ground levels assigned to elevations are going to be changing and this shift will vary geographically across the nation, with ranges -.06 to -3.9 feet. Major U.S. waterways traverse areas that will have very different shifts to their vertical datum. The northernmost reaches of the Mississippi River will see a -80 to -90 centimeter shift while its southernmost portion will only have a -17 to -20 centimeter shift, with many gradations in between. NAVD 88's coverage stops at the shoreline, while NAPGD2022 will reach far off the shore offering broader applicability and providing a consistent vertical datum that all users can reference. The ellipsoid exists as a geodetic reference all over the world and GNSS or GPS receivers natively reference ellipsoid heights. Converting everyone to this same vertical datum is not easy to implement because conversion from ellipsoid datum to another reference is challenged by sparse data coverage. Vertical land motion also presents challenges to conversion. Using ellipsoid heights as a surface reference is theoretically possible, but not feasible with the existing resources that NOAA has. VDatum is a part of the answer, but it has a very small team, sparse coverage in some areas, and ongoing subsidence means that coverage must be updated routinely. Users of ECDIS and other systems view doing the math between datums as a liability, so it is incumbent upon the government to do the data harmonization before disseminating data. Accurate conversion from ellipsoid to common water level datums is key, and higher density data is needed for higher accuracy datum transformations. More support is needed for VDatum and related models and products, such as GNSS on Tidal Bench Marks, improved topographic sea surface modeling, and monitoring of vertical land motion.

Commenters:

Sam Knight, Director, Product Management, Blue Marble Geographics, said he really liked the idea of reducing the mental gymnastics required to reconcile the various reference surfaces. In his work with coordinate transformations he has found that this is a tricky thing for the average user. The VDatum grids are the single largest data grid that Blue Marble supports. For companies producing navigation equipment, the idea of removing some of the transformation taking place on their hardware is very appealing. EGM2008, which is a worldwide geoid with one minute grid spacing, has a total data size of about 1 gigabyte; VDatum only covers the U.S. coasts and has a total data size of about 5 gigabytes. Increasing the data density in VDatum, as was suggested, would cause its size to balloon even further. Liabilities are a very real concern for manufacturers. The need for standardization is obvious; imprecise nomenclature or too many options within conversion tools can lead to confusion. There needs to be an acknowledgement of what the "zero" was when the data was created, when the data was last updated, what system was used, etc. The new terrestrial reference frames are going to make things easier in the long run but it will be a big challenge to get there. The ellipsoid as a reference is effectively meaningless to the average user, but is going to be important; making it simple enough for the end user but also powerful enough to do the job accurately will not be an easy task.

Dr. Neil Weston, Chief Scientist, OCS, NOS, NOAA and Affiliate Research Professor, University of New Hampshire, Center for Coastal and Ocean Mapping, UNH-NOAA Joint Hydrographic Center, said that there is a big push for international standards so we can have interoperable systems. ENCs are able to display a lot of different types of data and, more often than not, those data are referenced to different coordinate systems. A common coordinate system is needed from which transformations can be done and information accurately displayed. NGS Regional Advisors are great resources when users have questions about the geodetic aspects of a coordinate system; OCS and CO-OPS are also helpful in regards to questions about vertical components. Under keel clearance systems are an international challenge.

When ships come from one nation to another and load up their ENCs, they want to be able to have the information displayed accurately. Being able to graphically display information is desirable because it is much easier to interpret than tables. OCS and CO-OPS model the Columbia River region and have node density. They need to find a way to make these measurements available to the pilots in real time or near to it. OCS will do its part in assisting with adapting to the datum changes as one transits a river. They will also continue to push for PORTS in more regions across the nation because of the value it provides to mariners. The more air gap sensors they can install, the better. Dr. Weston concurred with the value of using the ellipsoid as a reference as it is readily available, but it requires a learning curve that will take time. He strongly suggested continued support for the VDatum team and their efforts to produce a more accurate tool for mariners.

HSRP Q&A

Qassim Abdullah commented that he completely agrees that datums have to be unified, but emphasized that the accuracy of all the hydrospatial measurements need to be considered. He also noted that 19 bridges with air gap sensors seems like far too few for the nation and wondered if CO-OPS could partner with local communities to install more.

Lindsay Gee said he felt NOAA has the responsibility to build out this invisible infrastructure and make available to mariners the data it produces, while also being able to allow others to contribute. He wondered what the overall uncertainty is for not just all these measurements, but also for the ship itself, and asked if there have been trials to track ships to determine the accuracy of measurements for things like squat.

Nathan Wardwell emphasized the value of having co-located GNSS stations at tide stations. Many tidal datums use differing tidal datum epochs, and in much of Alaska they do not even reference an epoch because there are not enough NWLON stations to provide datum control. Major rivers are critical to Alaskan communities and they have very little information supporting them. He added that users of data are going to want it referenced to a something that considers gravity, so transformations would still be necessary even if users converted to ellipsoid heights.

Tuba Özkan-Haller said surface gravity waves are a major consideration on the Columbia River, as they generate 25+ foot waves in the wintertime. Another issue is that the navigational channel fills in over the course of a year. There is research in this area that is relevant, particularly deriving bathymetric information from remote sensing observations carried out in real time. She would love to see NOAA incorporate some of that understanding and perhaps produce real time views of what the bathymetry is as it is evolving.

Public Comment

Lynne Mersfelder-Lewis read the following comments received during the second day of the meeting:

Joyce Miller: In the Public Private Partnerships draft, could the Panel provide some specific examples or recommendations for PPP? Either specific partnerships that might be beneficial or mechanisms to facilitate PPP? Also, does the NSRS update paper accurately reflect the timeframe in which the updates will occur? It was originally 2022, but Juliana Blackwell's presentation indicated much later than that.

Andrew McGowan, Regional Geospatial Coordinator, Lynker: NOAA OCM: Publicly shared, processed BAGs or other end product surfaces in one location for all NOAA and NOAA Grantee survey work.

Alberto Costa Neves, Hydrographic Science Program Coordinator, University of Southern Mississippi: Continue engaging with the broad stakeholders as you currently do.

Joyce Miller: Suggestion: Supply chain would be a very timely topic in Hawaii, which has a two-week food supply on island if its ports were impacted by a tsunami or hurricane.

Denis Hains: I like the term "BlueTopo," however I would suggest considering to use the term "hydrospatial." Hydrospatial includes the BlueTopo as it is all about the blue of our blue planet and its contiguous zones. It does not replace hydrography, it is about ocean spatiotemporal mapping, exploration, and characterization of the blue, including coastal and flooding zones. For more info - visit and read the info of the Hydrospatial StoryMap at: https://arcg.is/19fiab

Paul Devine: What about vessel "squat" in opposing currents - predictions?

Jon Dasler: Nice presentation by Sean Duffy. To clarify, The MuST system is being designed by the University of Washington Applied Physics Lab through a Department of Defense grant to image buried ordnance. David Evans and Associates, Inc., is providing operational support and consultation. The image of the aircraft was a 3D image with portions of the aircraft below the seafloor.

Jon Dasler: Nice presentations by Julia, Sean, Chris, Duffy, Jeff, and Captain Amos. To the point on bridge inconsistencies: based on some recent experiences, it is my understanding that many U.S. bridges with critical clearances have published heights that may be inaccurate, unverified, relative to outdated datums, or based on original design drawings. Pilots are facing a number of issues regarding bridge heights on the Columbia and Mississippi rivers. On the Columbia there is a push for cruise ships to procure services from the shipyard in Portland that sports the largest floating dry dock on the west coast. In addition, MSC is intending to send larger container ships to Portland. These transits require pre transit measurement of air draft, laser scanning of the bridge for accurate air draft over a given span width (not a point measurement) and tide coordinated passages to clear bridges on the Columbia River. Pilots are requiring real time monitoring when clearance is forecast at less than 10-feet. There are also issues with broken links in the line of authority of official bridge heights when there is not a precise survey by the owner where owners are responsible for providing clearance but there are no set guidelines. Recent discussions with a department of transportation on bridge clearance issues included the statement that they would not fund a survey but if done by a professional survey firm they would accept the survey and submit it to the USCG, that could then submit it to NOAA for charting.

Questions to Admiral Evans: Has NOAA considered a national effort to survey bridge clearances in areas charted by NOAA so charts can be updated with accurate clearance heights? Is there an ongoing effort started by Admiral Smith and Admiral Brennan to harmonize river gradient datums and the interface with MLLW between USACE and NOAA? It is still an issue on the Mississippi and Columbia rivers.

To Julia Powell or Admiral Evans: Has NOAA evaluated new methods in addition to or in concert with S-100 to portray bridge clearances in a more detailed manner on ENCs, rather than publishing a single height per bridge or bridge span?

Andrew MacInnes: Does NOAA incorporate macroeconomic factors and global trade in the US economy when considering shipping and navigational investments? For example, many ports talk about the growing size of ships visiting. NOAA should consider for example: (1) Oil imports, auto imports from Europe, and container trade with Asia/China may not increase at the same rate as they have over the past thirty years; and (2) Some cities and metropolitan areas are no longer suited to be logistics centers for various reasons. Concentrating large incoming ships into several ports may make economic sense providing scale to some ports while allowing others to be repurposed. Not every port city needs to modify its entire local infrastructure (collectively, nautical ports, local roads and highways, rail, and airports) to accommodate the world's largest ships (e.g., New York/New Jersey). How can NOAA encourage the relocation of maritime assets around the country?

Denis Hains: On Vdatums, if it is not already in place, it is suggested to consider having a formal multidisciplinary team of professionals including: coastal zone managers; environmentalists; coastal engineers; power lines engineers; hydrologists; hydrographers and other professionals in US and in neighboring countries; led by geodesists or facilitator, to address the needs and requirements for an integrated vertical datums separation and epoch model to the reference ellipsoid in the hydrospatial domain. All this in communication with all stakeholders such as: marine pilots and insurance companies.

Jon Dasler: Admiral Evans: Is NOAA pursuing any national infrastructure funding for bridges to support air gap sensor installation and accurate bridge surveys? Another option may be the Richard Brennan cooperative funding with state transportation departments.

Jon Dasler: The discrepancies in datums between USACE and NOAA is still a problem.

Chrissy Hayes: In the PPP issue paper, please also include Hawaii as well (as Alaska)!

Alberto Costa Neves: I am very glad to see the support from HSRP members to paper chart, an all-times-relevant tool for sailors. I believe the message of ending paper chart has been badly expressed. It is important to leave the door open for industry and interested sailors to still be able to obtain/produce a paper chart, based on the most updated database.

Pamela Chelgren-Koterba: I heartily endorse the other speakers' comments about NOAA assisting POD Vendors with (~3) templates to use that will satisfy the issues that Ann/Anne raised.

Andrew MacInnes: Professional maritime is in decline. The future is recreational boaters in small vessels. Paper charts with better near-shore details will encourage people to enjoy the waterways.

HSRP Discussion: HSRP Priorities, Issue Papers, Working Groups, other topics

Dr. Dave Maune, Co-Chair, HSRP Planning and Engagement Working Group, moderated the discussion on the Panel's three draft issue papers. Dr. Maune discussed the draft issue paper addressing public-private partnerships and the need for NOAA to establish these partnerships for data acquisition in order to meet their NOMEC goals. He discussed two of USGS' successful uses of public-private partnerships by utilizing Broad Agency Announcements. Private companies opportunistically investing in speculative acquisition around Alaska saved USGS an estimated $30 million and these partnerships could be more cost-effective for NOAA in the long run. He has received positive feedback from NOAA on the issue paper. HSRP member comments included: this paper is timely given the similar push from the National Geospatial Advisory Committee; once the partnership is established, NOAA needs to market the value of the work in order to get in other funds; this is the only model, but having the option and making all parties aware of it is critical; this paper is useful because it gets the government side thinking about new models, which are much needed. The issue paper was unanimously approved as written.

Lindsay Gee briefly discussed the proposed comments to NOS' request regarding data licensing, summarizing the HSRP's feedback from the previous day. HSRP members comments included: there is a need to hear about data delivery issues for precise navigation; they should consider how this could benefit other parts of NOS; they may want to address data accuracy and quality control as the data moves through various products later on. These comments will be included as an attachment to the HSRP's letter to the Administrator following the meeting.

Gary Thompson discussed updates to an issue paper on the NSRS modernization from 2018. Implementation of the new NSRS has been delayed, so they removed references to a 2022 release and updated some of the wording and graphics. Otherwise, the paper is largely unchanged. Ms. Blackwell noted that a few references to 2022 still needed to be removed. Mr. Scott added that 2022 will remain in the names of the new datums. HSRP member comments included: the title could be shortened to add

clarity on the purpose of the paper; it would be nice to include Alaska on the graphic since it will be experiencing some of the largest changes to its datums. The issue paper was unanimously approved with minor modifications to be decided later by poll.

Captain Ann Kinner and John Nyberg, Deputy Hydrographer, OCS, NOS, NOAA, discussed the updates to the boater issue paper, which was updated to include the raster paper chart transformation. The paper centers on the importance of paper charts for small crafts and highlights the role that paper charts can play for safe navigation, particularly as a backup to ENCs and as a training tool. The previous version of this issue paper from 2017 references many products that no longer exist or are being withdrawn. This version of the paper highlights what members would like to see continue. Users will need to know how to find the charts they need and get the information they are accustomed to working with. Recognizing the inherent vulnerability of digital systems, the paper makes several recommendations to NOAA. HSRP member comments included: the history of paper charts is meaningful to many people and getting rid of them entirely would be a bad idea; paper charts are essential tools for teaching and for recreational boaters; the problem with ECDIS systems is that boaters get tunnel vision and focus more on where they are and not where they are going; while paper charts are currently still needed, it is only a matter of time before they are no longer necessary; if someone wants to print out a paper chart it should be their responsibility and not up to NOAA to do this, because they are obsolete the moment they are printed; whether NOAA has handled this transition well requires assessing. Dr. Nyberg said OCS is working with the IHO on standards for producing paper charts using ENC as a source. He stressed that phasing out paper chart productions was not an easy choice for NOAA but the team is working to address many of the issues raised by the HSRP. He encouraged members to explore OCS' historical chart collection. The issue paper was unanimously approved as written, though graphics will be added later and there may be minor tweaks.

Nicole Elko proposed a coastal resilience issue paper to be discussed at the fall meeting. The Panel has previously discussed an update to their sea level rise issue paper that would incorporate some resilience elements. Coastal resilience is a broad topic, so the paper would focus on those areas that are most relevant to hydrographic services and what part of resilience NOAA may need guidance on. NOAA's role in sediment management and parallels between challenges with air gap and water level measurements were two highly relevant topics. The paper may also highlight issues such as inconsistent datums and the arithmetic that local stakeholders are expected to perform to apply the data NOAA provides to their own situations. HSRP member comments included: the issue touches many different parts of NOAA and other federal agencies; with the funding that is going to be made available to address the climate change, it is important that NOAA have help informing their decision making to ensure it is spent in effective ways. Mr. Wardwell offered to contribute to bring an Alaska perspective to the paper's content. HSRP staff will reach out to members to see if they are interested in forming a small group to work on the paper.

Julie Thomas led a discussion on the HSRP priorities matrix. She reviewed each of the priorities to ensure they were still relevant to the Panel's vision, discussed the current status of each, and entertained suggestions on modifications. At the next meeting of the Planning and Engagement Working Group, they will concentrate on a few priorities for the September meeting.

Meeting Recap and Round Robin with HSRP Members, Letter to the Administrator, and Wrap Up

Julie Thomas led the recap and members shared some of their priorities to be included in the letter to the Administrator, including: the challenges of sea level rise and vertical land motion are important topics for the future; members would like a future session on datums and coastal modeling or a speaker from 3DEP to discuss topobathy; the issue paper session was impressive and demonstrated the amount of work the Panel is accomplishing; members were pleased to see the session tying together practical applications of NOAA data and how important it is for the supply chain to maximize vessel loading and ease of passage; a new volunteer will need to step forward to lead the production of issue papers as September will be Dr.

Maune's last HSRP meeting; however NOAA moves forward on public-private partnerships, they should provide some kind of liability protection to data providers who submit their data in good faith; the datum session was very well done and especially strong because it affected every Panel member's area of interest; getting real data out of sensors would be a good topic for a future panel; the potential and real time benefits of digital twinning is something NOAA should be exploring, as it provides a much more informed picture of what is going on; data licensing is a huge lift for NOAA, but they should also include quality of the metadata as part of the effort and without national standards all of these efforts fall apart. Members were invited to send in additional thoughts on what they would like included in the letter to the Administrator. Mr. Edwing responded to a few things mentioned during the datums session. PORTS is a form of public-private partnership and anyone can approach CO-OPS about getting an air gap sensor installed, though coming up with that funding can be a challenge. As far as how many air gap sensors are needed, that is undetermined, though he agrees that 19 is too few. Another way to come at the issue is whether U.S. Department of Transportation should be funding state DOTs to install air gaps on their bridges. CO-OPS is looking at revising their protocols on what measurement they use for each epoch or if more frequent updates are needed. RDML Evans said that uncertainties have crept into NOAA products over time, and now that tolerances are smaller, it has become apparent how much those matter. There has been some focus on the administrative challenges of figuring out who really is the source authority for some of these measurements. While it is a legitimate issue, it is an unsatisfying answer for not getting it right. He deeply appreciates the issue papers as they provide critical input even when it is not always comfortable. He appreciates the idea of revamping the sea level rise paper and knows that Dr. Spinrad and Ms. LeBoeuf would as well. Trying to constrain it to the things that are within the control of the three offices will be important.

Next Meeting

The next HSRP meeting will be September 13-15, 2022.

The meeting was adjourned at 5:40 p.m.

HSRP VOTING MEMBERS IN ATTENDANCE:

Qassim Abdullah, Ph.D.	Vice President and Chief Scientist, Woolpert, Inc.; Adjunct Professor, Penn State University and University of Maryland Baltimore County
Capt. Anuj Chopra	CEO, ESGplus LLC
Capt. Alex E. Cruz	Owner, West Indies Marine Services, and Vice Chairman, Couth Coast Harbor Safety Committee, Puerto Rico
Sean M. Duffy, Sr., Co-Chair	Executive Director, Big River Coalition
Nicole Elko, Ph.D.	Science Director, American Shore and Beach Preservation Association; Executive Director, South Carolina Beach Advocates; President, Elko Consulting
Lindsay Gee	Mapping and Science Coordinator, Ocean Exploration Trust
Deanne Hargrave	Geoscience Manager, Atlantic Shores Offshore Wind LLC
Capt. Ann Kinner	Owner, Seabreeze Books and Charts; Chair, San Diego Harbor Safety Committee
David Maune, PhD	Associate Vice President and Senior Remote Sensing Project Manager, Dewberry Engineers, Inc.
Capt. Anne McIntyre	Business Manager, San Francisco Bar Pilots
Dr. H. Tuba Özkan-Haller	Acting Dean and Professor, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
Edward J. Saade	President USA, Fugro Inc. and Group Director Americas (ret.)
Julie Thomas, Co-Chair	Senior Advisor, Southern California Coastal Observing System; Program Manager, Coastal Data Information Program, Scripps Institution of Oceanography (ret.)

Gary Thompson	Deputy Risk Management Chief and Chief, North Carolina Geodetic Survey, North Carolina Department of Public Safety
Nathan Wardwell	Managing Partner, JOA Surveys LLC

NOAA and NOS LEADERSHIP PRESENT:

Nicole LeBoeuf	Assistant Administrator, National Ocean Service (NOS), NOAA
Glenn Boledovich	Policy Director and Chief of Policy, NOS, NOAA
RDML Benjamin K. Evans	Director, Office of Coast Survey (OCS), NOS, NOAA, and HSRP Designated Federal Officer
Capt. Andy Armstrong (NOAA, ret.)	Co-Director, UNH-NOAA Joint Hydrographic Center, University of New Hampshire
Juliana Blackwell	Director, National Geodetic Survey (NGS), NOS, NOAA
Richard Edwing	Director, Center for Operational Oceanographic Products & Services (CO-OPS), NOS, NOAA
Dr. Larry Mayer	Director, Center for Coastal and Ocean Mapping, and Co-Director, Joint Hydrographic Center, University of New Hampshire

NOS AND NOAA STAFF PRESENT:

Lynne Mersfelder-Lewis, HSRP Program Coordinator

Mike Aslaksen, NGS

Ashley Chappell, OCS

Melanie Colantuno, CO-OPS

Virginia Dentler, CO-OPS

CMDR Briana Hillstrom, OCS

Dr. John Nyberg, OCS

Amanda Phelps, OCS

Galen Scott, NGS

Jill Stoddard, OCS

SPEAKERS:

Capt. Paul Amos, Pilot, Columbia River Pilots

Dr. Brian Calder, Research Professor and Associate Director, Center for Coastal and Ocean Mapping and NOAA-UNH Joint Hydrographic Center, University of New Hampshire

Chris DiVeglio, Maritime Service Program Manager, NOAA

Sean M. Duffy, Sr., HSRP Co-Chair and Executive Director, Big River Coalition

Derek Hanson, Attorney-Advisor, Weather, Satellites, and Research Section, NOAA Office of General Counsel

Deanne Hargrave, HSRP Member and Geoscience Manager, Atlantic Offshore Wind LLC

CDR Briana Hillstrom, Chief, Hydrographic Services Division, OCS, NOS, NOAA

Jeff Jalbrzikowski, Regional Geodetic Advisor, NGS, NOS, NOAA

Sam Knight, Director, Product Management, Blue Marble Geographics

Tony LaVoi, Chief Data Officer, NOAA

Guy Noll, Associate Director, Esri Mapping Systems

Julia Powell, Chief, Navigation Services Division, OCS, NOS, NOA

Dr. Kurt Schwehr, Software Engineer, Google, and Affiliate Research Professor, University of New Hampshire, Center for Coastal and Ocean Mapping

Randy TeBeest, Deputy Assistant Administrator for Programs and Administration, NOAA Office of Marine Aviation Operations

Dr. Neil Weston, Chief Scientist, OCS, NOS, NOAA

Matt Wilson, Physical Scientist, Hydrographic Surveys Division, OCS, NOS, NOAA

ATTENDEES:

Name

Antonio Abeleira

Brent Ache

Jeff Akers

Kurt Allen

Nicolas Alvarado

Jeffery Andrews

Courtney Barry

Megan Bartlett

Colin Becker

Aviva Ben Shitrit

Rachel Bobich

Rita Bowker

Mary Bourgoyne

Steve Brodet

Deborah Brooks

Scott Brotemarkle

Daniel Brousseau

Kurt Brown

Doug Brunt

Patrick Burke

Krystal Butler

Thomas Butkiewicz

Dana Caccamise

Leslie Canavera

Dana Caccamise

Edward Carlson

Pamela Chelgren-Koterba

Robert Chen

John Conyon

Jose Cordero

Alberto Coast Neves

Kyle Crawford

Jason Creech

Abrian Curington

Cayla Dean

Sam Debow

Lauren Decker

Paul Devine

Catherine Dietrick

Geoffrey Douglass

Rob Downs

Claire Enterline

Rod Evans

Colleen Fanelli

Jeffrey Ferguson

Ashton Flinders

Christine Gallagher

Andres Garrido

Patricia Gaynor

Brandy Geiger

Phuntsok Geleg

John Gerhard

Heather Gilbert

Sherryl Gilbert

Kyle Goodrich

Carl Gouldman

Coty Granger

Megan Greenaway

Denis Hains

Bill Hanson

Simon Hardern

Karen Hart

James Haussener

Chrissy Hayes

George Hayes

Kim Holtz

Matt Hommeyer

John Howes

Michael Huskilson

Julian Inasi

Stephanie Ingle

Michael Jarvis

Inseong Jeong

Kevin Jerram

Shawntel Johnson

Rex Jones

Jena Kent

Nic Kinsman

Martin Klein

Liz Kretovic

Marta Kumle

Ed Kuwalek

Monique LaFrance Bartley

Jason Ledet

Aviva Levy

Xiaopeng Li

Carolyn Lindley

Nathan Littlejohn

Meme Lobecker

Nina Loutchko

Michael Lowiec

Mark Luther

Stephen Lyman

Mark MacDonald

Andrew MacInnes

Christopher Macon

Shawn Maddock

Matthew Malphurs

Louis Maltais

Giuseppe Masetti

Alexis Maxwell

Bob McConnaughey

Andrew McCoy

Adam McCullough

Meghan McGovern

Andrew McGowan

Michael Michalski

Joyce Miller

Crescent Moegling

Thomas Moore

Gail Morrison

Kolleen Mortimer

Bob Moshiri

Gregory Mount

Steven Murawski

Samm Newton

Ashley Norton

Victoria Obura

Jacquelyn Overbeck

Hadley Owen

Robert Pacunski

Robert Partee

Chris Paternostro

Meredith Payne

Eric Peace

Shachak Peri

Derrick Peyton

Julia Phelps

Amara Pouv

Julia Powell

Peter Ramsay

Glen Rice

Robert Richards

Jack Riley

Starla Robinson

Colleen Roche

Gerardo Rojas

Daniel Roman

Greg Rudolph

Jay Satalich

Derrick Savage

Miki Schmidt

Hal Shiels

Lee Shoemaker

AB Stone

Quentin Stubbs

Peter Swanson

Charlene Sylvester

Caleb Taylor

Patty Taylor

Elena Tolkova

Cristina Urizar

Praveen Vamadevan

E.J. Van Den Ameele

Jorge Viso

David Walsh

Meredith Westington

Marian Westley

Jeremy Wetzel

Douglas Wood

Daniel Wright

Darren Wright

Katrina Wyllie

Hua Yang

Abraham Yehuda

Caitlin Young