Meeting Summary
Hydrographic Services Review Panel
March 5-7, 2019
Washington, DC

Tuesday, March 5, 2019

On the call of the Designated Federal Official (DFO), Rear Admiral Shepard M. Smith, NOAA, the Hydrographic Services Review Panel (HSRP) meeting was convened on March 5-7, 2019, at the Hall of States, 444 North Capitol Street, NW, Washington, D.C. 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.htm

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.

Welcome, Introductions, Goals, and Deliverables

Ed Saade, HSRP Chair called the meeting to order at 9:06 a.m. He reviewed the meeting's agenda and welcomed attendees, in particular NOAA, U.S. Coast Guard (USCG), and U.S. Army Corps of Engineers (USACE) leadership and Congressional staffers. He thanked NOAA staff for providing essential services during the more recent government shutdown.

Rear Admiral Shepard Smith, Director, Office of Coast Survey, and HSRP Designated Federal Official, welcomed new HSRP members Captain Anuj Chopra, Deanne Hargrave, and Captain Ann Kinner. RDML Tim Gallaudet delivered the oath of office to the new members and congratulated them on their role as public stewards. RDML Smith discussed logistics and goals for the meeting.

Nicole LeBoeuf, Acting Assistant Administrator, National Ocean Service, commented on the progress made following the last HSRP meeting, particularly from meeting with the IOOS Advisory Committee and the Alaska Mapping Executive Committee (AMEC). Partnerships like these are key to advancing shared objectives. There is a heightened need to reinforce the nation's infrastructure in order to plan for an increasingly uncertain future, and the programs HSRP advises are at the core of that effort. Three key areas that NOS would like HSRP input on in the future are:

- Modernization. NOAA wants to remain on the cutting edge of technological advancement and be nimble enough to respond to new developments.
- NOS' role in emergency response. NOS is increasingly being asked to get more involved in this area. They currently provide a wealth of data and information to responders but only a fraction of what they could potentially offer.
- Sea level rise and other factors that will impact planning for the future. Sea level rise will be a significant issue in the future and NOS is ideally poised to assert leadership in this area. NOS would like the Panel's input on how best to utilize, leverage, and potentially augment NOS expertise and capacity in sea level rise.

The NOS FY19 budget for HSRP-related programs is mostly flat other than some notable increases for hydrographic surveys, additional funds to repair some NWLON stations, $75 million to help recapitalize NOAA's aging fleet, and additional funds towards the backlog of deferred maintenance. Ms. LeBoeuf

expected austere budgets for the next few years, which makes continual messaging of what the program offers and how valuable it is to the nation so important. She appreciated the HSRP's issue paper on precision navigation and encouraged the Panel to continue pushing the envelope on the topics under their purview.

Rear Admiral Tim Gallaudet, Ph.D., USN Ret., Assistant Secretary of Commerce for Oceans and Atmosphere, NOAA, discussed the transition of Dr. Neil Jacobs into the roles of Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator and RDML Gallaudet returning to his position as Assistant Secretary of Commerce for Oceans and Atmosphere. The transition was smooth and comes out of Secretary Ross' acknowledgement of the advances made on the weather side of NOAA and the need to let RDML Gallaudet focus on advancing the wet side. Advancing navigation services is a top priority for RDML Gallaudet, along with ocean exploration, the National Oceanographic Partnership Program, coral reef conservation, and fisheries. The maritime sector continues to expand and NOS' work has never been more important. The national security aspects of navigation services and reducing the seafood trade deficit have been a major focus areas for the Department. The new White House Science Advisor, Dr. Kelvin Droegemeier, has called for a "second bold era" in American research and development, which sees the U.S. as being in the same position it was following World War II, when government-led science initiatives built the space program among other technological accomplishments. The difference now is that the private sector is taking on a larger role, and NOAA intends to capitalize on this.

RDML Gallaudet discussed things that happened since the previous HSRP meeting in August, including CAPT Andy Armstrong being named to the Hydrographic Society of America's Hall of Fame, NGS' continued progress in GRAV-D (Gravity for the Redefinition of the American Vertical Datum) collection, advancements in surveying technology, repairing and upgrading water level monitoring sites, and the outstanding response work of the Navigation Response Teams. RDML Gallaudet has been working with RADM John Nadeau on making more NOAA data available via AIS, which will increase safety for mariners and avoid incidents like the sinking of the *El Faro*. RDML Gallaudet may be taking on the role of Chair of the Committee on the Marine Transportation System (CMTS) in August, and he asked the HSRP to consider what he can do in that capacity to advance hydrographic issues. The White House is increasingly interested in the Southwest Pacific as an area of key strategic importance for the country and NOAA will be working to fulfill their hydrographic mission in the region.

Thomas P. Smith, P.E., SES, Chief, Operations and Regulatory Division, LRD/NRD Regional Integration Team Leader, Directorate of Civil Works, U.S. Army Corps of Engineers, discussed USACE's role, along with other federal partners, in maintaining the nation's navigation system. The federal government has varying levels of responsibility for 1,067 ports and harbors across the nation, 13,000 miles of coastal and deep draft channels, and 12,000 miles of inland waterways. USACE undergoes a performance-based budgeting process every year to determine which channels they can maintain to the authorized depth and width. The agency focuses resources primarily on high use (>10 million tons) projects with the help of contractors. Areas of collaboration between USACE and NOAA include obstruction surveys, Category Zone of Confidence (CATZOC) on NOAA charts, consistency of information in NOAA charts and USACE survey plots, and high-resolution multibeam data for the national dataset. eHydro is the data management tool by which USACE data is made available to NOAA and which enables it to be displayed on NOAA products. It has been out for a few years and USACE believes it has great potential. Mr. Smith discussed contingency operations currently underway in the Southwest Pass at the mouth of the Mississippi River where sustained high water conditions are generating extensive shoaling, affecting four of the nation's major port systems and the entire inland navigation system.

As ships get bigger, more ports want deeper channels, and there is tremendous pressure on USACE to authorize, deepen, and maintain those channels. Long-term maintenance costs are always a concern. For

USACE to accomplish its mission, continual discussion with environmental partners is necessary. USACE believes that improved technology and use of data is a game-changer for how it delivers its mission.

Rear Admiral John P. Nadeau, Assistant Commandant for Prevention Policy, U.S. Coast Guard, discussed the U.S. Marine Transportation System (MTS) assets that support $4.6 trillion of economic activity. Since becoming Commandant of USCG, Admiral Karl Schultz has focused the Coast Guard's lines of effort on facilitating lawful trade and travel on secure waterways, modernizing aids to navigation and mariner information systems, and transforming workforce capacity and partnerships. RADM Nadeau encouraged HSRP members to familiarize themselves with USCG's ten-year Maritime Commerce Strategic Outlook, as it contains many overlaps with NOAA's mission. USCG is focused on delivering the information a mariner needs, presented in a format they are comfortable with which allows them to make risk-informed decisions along their transit. While USCG is not moving toward getting rid of physical aids, the advantages of electronic aids are myriad, including allowing for recovery efforts when physical aids have been damaged or dislocated by a storm.

USCG-NOAA partnerships are essential to maximizing the utility and efficiency of their respective operations to handle larger ships, more users, and autonomous vessels. The public expects minimized environmental footprints on the system, which is a good goal but creates challenges for industry and operators to accommodate those demands. USCG wants to be part of the team delivering solutions that will make all of this successful in the future.

HSRP Q&A

RDML Smith said other nations have very strong port authorities with the ability to levy taxes on ships using the waterways to help pay for the dredging. The information and services that port authorities around the world provide their ports are, in the U.S., jointly provided by NOAA, USACE, and USCG. Many of the initiatives these agencies have been jointly undertaking to improve the service to U.S. ports are more like the community of practice of foreign nations' port authorities.

CAPT Kinner said that many small craft boaters don't know how to use charts and she is concerned about the shift toward overreliance on electronic navigation, particularly given GPS' vulnerability. RADM Nadeau said he sees the new technology supplementing what is they currently use, not replacing it. In all cases, USGS is engaging stakeholders to understand user requirements for waterways. There are always budgetary pressures to scale back on physical aids, but they need to be sure these needs are met. CAPT Kinner said more education and outreach is needed, especially on the west coast.

Ed Kelly asked where there may be opportunities for synergy between the three key agencies involved in the MTS in terms of sharing and coordinating resources and data. Mr. Smith said engagement at the higher level is most effective when taking on specific issues through work groups. At the regional level, interaction needs to be undertaken with an understanding of the needs of the local community. RDML Gallaudet said USCG and NOAA are moving forward with making more information available over AIS. They are also moving forward on outfitting USACE survey vessels with multibeam and the appropriate QA. The agencies will be sharing training facilities and resources on autonomous platforms for a variety of missions. Nicole LeBoeuf said she would like to see the federal agencies that have coastal-dependent infrastructure talk to one another about what the future will hold, in terms of both sea level rise and infrastructure.

Ed Page asked how liquefied natural gas (LNG) is changing maritime safety. He also asked if CMTS is looking at the possibility of large container ships being powered by LNG and whether OPA-90 will need to be revisited. RDML Gallaudet said LNG is a big part of why America is now a net energy exporter, but it does lead to increased risk in certain areas. Technology and data sharing will allow for it to continue

safely. RADM Nadeau said they are seeing more LNG and it makes a lot of sense given the .1% sulfur content restrictions for new construction. He believed most ships will continue to run on oil for the foreseeable future.

Chair Saade asked who would have jurisdiction for dealing with unexploded ordnance on the seafloor within 14 miles from the coast in federal waters. This is an issue contractors working on offshore wind farms have encountered. RADM Nadeau said USCG's authority would be tied more closely to the vessels involved than with handling the ordnance. Mr. Smith said there is a similar issue with pipelines, which are expanding rapidly in federal channels. There is no single entity with full responsibility. Ms. LeBoeuf said they have a good partnership with the Bureau of Ocean Energy Management (BOEM) and have developed the Marine Cadastre tool for this kind of situation and will soon be releasing the Ocean Reports Tool which will provide a 3-dimensional picture of all available data for an area of the ocean selected by the user. This tool is ideal for wind farm developers, aquaculture, and hydrokinetics. Dr. Mayer said DoD, DOE, and EPA have a joint office called SERDP/ESTCP charged with finding and developing UxO technologies and probably have a database of this sort of information.

HSRP Special Session: Panel on Congressional Perspectives on Hydrographic Services

Sean Duffy, Sr., Big River Coalition, and HSRP member, discussed Congressional advocacy on issues facing the Mississippi River. The Mississippi River system connects more miles of navigable waterways that the rest of the world combined. High water has been a big challenge lately, with most of the basin being wetter now than it has been in 124 years. In his work, Mr. Duffy relies heavily on federal partners and spends much of his time pressing for additional funding for their efforts to recover the channel. He has gone through many disaster recovery efforts, beginning with Hurricane Ivan. The President's budget for the Mississippi River is inadequate; more than double the proposed amount is needed. There are many challenges to maintaining the system, but we need to be talking about the future and get away from inadequate funding. Advocates must be willing to meet with Congressional members, have a list of desirables, and make a lasting impression. Memorable phrases that capture the issue in the brief time available with members of Congress can be very effective.

Glenn Boledovich, Director, Policy Coordination and Analysis Division, Office of Management and Budget, NOS/NOAA, discussed potential opportunities in the new Congress related to the National Ocean Policy and the blue economy in the context in NOAA's navigation and observing systems. The Administration has not put forward much legislation related to the ocean, but has released an Executive Order that recognizes certain activities where NOAA plays an important role, including maritime commerce, recreation and tourism, and fisheries. As a mechanism to advance these interests, the Ocean Policy promotes improved public access to marine data and information, as well as interagency coordination and engagement with industry, the scientific community, and other stakeholders. The programs of NOS are well-reflected in the Executive Order and the blue economy initiative. There are many areas in which Congress could act consistent with these policies without creating something wholly new. Supporting better integration of the authorities they already have on hand may be valuable. This is especially true in the areas of marine data and information, where so many agencies play a role and there are existing frameworks for interagency coordination. Legislation to codify Digital Coast was introduced in previous Congresses and will likely be introduced again during the 116th Congress. One thing Congress might consider is an effort to better coordinate existing ocean and coastal observing and mapping authorities and programs. This relates to the work of the HSRP, as their joint meeting with IOOS in Juneau, AK, is exactly the kind of coordination the Ocean Policy promotes. The Panel is authorized to advise the NOAA Administrator and programs under their purview, but not Congress. Their efforts help inform and educate a broad range of people about the value and public benefit of these programs.

Sara Rothi-Gonzalez, Senior Counsel, Senate Commerce Committee, said that, though it is not the HSRP's job to advise them, Congress does rely heavily on the Panel's recommendations. Water-based

communities have sprung up across the nation, which is why Congress wisely put jurisdiction for Oceans and Atmosphere under the Commerce Science and Transportation Committee. Ms. Rothi-Gonzalez commended the Administration for wanting to quantify the blue economy in a more standardized way, as this makes for a more compelling story when requesting funding from Congress. The 116th Congress has some significant and bipartisan ocean and coastal issue champions, including Senate Commerce Science and Transportations Committee Chairman Roger Wicker and Ranking Member Maria Cantwell. There are opportunities here to make the case for the blue economy and why it is important for Congress to invest appropriately. Several bills have been put forward over the last few Congresses, such as reauthorization of the Integrated Ocean and Coastal Observing System Act and authorization of the Digital Coast Act, which have been passed through the Senate multiple times but have not been acted upon by the House. The House of Representatives' dynamics have fundamentally changed in this Congress and the House may now be more interested in taking up these bills. One of the challenges in better coordinating existing authorities is that the agencies are siloed, Congress itself is siloed, and within Congress the silos look different. On the Senate side, NOAA is wholly within the jurisdiction of one Committee; on the House side, NOAA jurisdiction is split between three different Committees, which also deal with several non-NOAA issues. Congress appreciates when outside entities can tell them where relationships lie between agency needs, because working in a very narrowly focused area can make it is hard to see those opportunities.

HSRP Q&A

Anuj Chopra said the net energy export boom is increasing exponentially, but the infrastructure is aging. He asked how Congress is looking to address this issue on a national scale. Ms. Rothi-Gonzalez said the issue of what an infrastructure bill would look like has been a big question for years. It is unknown whether it would be policy only or increased funding for new initiatives. There is a desire on both sides of Congress to come to more detail on what a blueprint for an infrastructure proposal would look like. Even a bold infrastructure proposal will likely not adequately reflect the needed investment. The U.S. needs a sustained, systematic way to capitalize infrastructure including energy. Canada is considering approving a new pipeline that would increase tanker traffic between the U.S. and Canada sevenfold, and America needs to assess whether we have the spill prevention and response capacity to handle it.

RDML Smith said coordinating international hydrographic efforts often runs up against national boundaries, where international shipping flows freely across boundaries but NOAA's authority stops. When thinking about resilience and global modeling, those types of silos are constraining. Ms. Rothi-Gonzalez agreed that for some issues boundaries are less salient. She would appreciate an itemized list of where those inadvertent boundaries are located in order to assist in breaking them down where possible.

Nicole LeBoeuf said she is keen on federal agencies working together more closely to prepare for sea level rise around coastal-dependent infrastructure. Mr. Duffy said that due to subsidence and sea level rise, it may be time to look at changing mean low Gulf elevations to adjust to the present circumstances.

Rich Edwing said that as Congress considers an infrastructure bill they will likely focus primarily on physical infrastructure, but fundamental data is needed to inform the construction of that physical infrastructure. Ms. Rothi-Gonzalez said people and platforms are needed. Platforms include intelligence from which to make better decision and the people to make the decision and find the information. She will continue to make that pitch, but the need on the gray infrastructure side is so great that the message is hard to get through. Using quantified arguments for the blue economy would be helpful.

HSRP Special Session: Stakeholder Perspectives, Priorities, and Partnerships for the Future: The Mission of the Navigation Services – data, products, and services

Ed Kelly, Maritime Association of the Port of New York and New Jersey and HSRP member, and Captain Jim Crocker, Chief, Navigation Services Division, Office of Coast Survey, moderated the panel highlighting collaborative approaches to working with NOS. Panelists also provided insight into how NOAA's navigation services portfolio and other partner data and services impact their operations and inform future program and product development. Speakers focused on specific products and services, the integration of new technologies, and provided requests and recommendations with a goal of providing a deeper understanding of stakeholder priorities.

Captain Jorge Viso, President, American Pilots' Association (APA), described services available to the harbor pilot community to enhance situational awareness and safety. The APA is a national association of the piloting profession. APA members handle over 90% of all the commercial large vessel traffic that uses American ports. Their role and official responsibility is to protect the safety of navigation and the marine environment in the waters for which they are licensed. PORTS is essential to pilots, particularly tidal current predictions and air gap sensors. NOAA forecast services are necessary, too, especially weather conditions and geographically specific forecasts that may be critical to a particular maneuver. Capt. Viso gave several specific examples of how pilots use PORTS across the country in ways critical to safe navigation and the maximization of throughput. Pilots appreciate visibility sensors, but they have been less reliable than other sensors that have been deployed. Being able to receive some PORTS information via AIS on portable pilot units (PPUs) has been very beneficial. Air gap sensors are critical as ships get bigger and tolerance shrinks. Graphical forecasts are useful for regional weather trends, particularly cold fronts, wind shifts, and fog developments. Marine channel forecasts are very localized forecasts that are useful for weather-critical chokepoints and weather-sensitive maneuvers. Capt. Viso asked that NOAA continue trending towards easy access and noted that some NOAA sites are a bit scattered. Pilots want to see more AIS delivery of PORTS information. This information is extremely useful and AIS delivery surmounts the problem of cell phone coverage. Continued cooperation between NOAA and other agencies has been very effective. Pilots would also like to see the expansion of bathymetric ENC surveys.

Dr. Qassim Abdullah, Chief Scientist, Geospatial Services, Woolpert, Inc., discussed the role of NOS' services in the day-to-day activities and success of the geospatial industry, for members of the American Society of Photogrammetry and Remote Sensing (ASPRS) and on Woolpert's surveying and mapping activities. The geospatial industry has reached new heights in data acquisition capabilities. The detail and locational accuracy of lidar has opened up many new possibilities and has become critical to all kinds of professions and uses. Lidar gives surveyors everything they need for seafloor or topographic mapping, as well as for engineering design. The factors that contributed to this success are advanced sensor technologies, geolocation capabilities, ground surveying techniques and survey monuments, and enabled processing software. NOAA has played a critical role in these areas. Useful NOS services include: CORS and OPUS projects, horizontal time-dependent positioning, access to aeronautical data, NGS coordinate conversion and transformation tool, VERTCON, tidal records, VDatum, and the NSRS modernization effort, for which NGS has done an excellent job preparing the industry.

Dr. Abdullah's suggestions for improvement included:

VDatum:

- More funding to support more frequent updates of VDatum
- Extend coverage shoreward to account for changing shoreline, eliminating existing coverage gaps, and convert airborne and vessel lidar shoreline coverage
- Incorporate river gradient datums, such as Mississippi Low Water Reference Plane and Columbia River Datum
- Geospatial community concerns over new National Tidal Datum Epoch (NTDE) impacts on VDatum and adequate funding for simultaneous update of all models on rollout
- Geospatial community concerns about whether NOAA will update the NTDE and VDatum simultaneously with 2022 NSRS rollout
- Extend coverage to Alaska, especially major ports and coastal communities
- Perform more robust GNSS ties at temporary tide stations
- Tidal datum and ellipsoid height information for many tidal benchmarks used in development of VDatum grids reference different epochs – combining tidal datum and ellipsoid height referencing different epochs introduces errors, especially in regions with significant vertical land motion

CORS:

- Enhance funding to support and expand
- Consider adding CORS stations collocated with CO-OPS tide stations where practical
- Extend CORS network to offshore platforms, islands, etc., to support ellipsoid reference surveying
- For new installations, select coastal sites suitable for both positioning and measuring water levels via GNSS reflectometry

Precision navigation:

- Obtain funding to expand precision navigation products to all deep draft ports to support increasing demands of maritime commerce on ports, harbors, and approaches
- Improve water level forecasts and near-shore bathy around arctic communities

NWLON:

- Enhance funding to support and expand
- Publish relationship of NAVD88 to tidal datums page for all published stations
- Extend offshore observations (buoys, platforms, bottom mount gauges, etc.)
- Consider expanding network through GNSS reflectometry, especially in challenging coastal environments such as Alaska
- Improve GNSS ties at NWLON stations by leveling ties between NWLON stations and nearby CORS, and more robust GNSS observations
- Consider using modified five-year epoch for all tide stations to provide more consistency between tidal datums and ensure currency of tidal datums

Chris Edmonston, President, BoatU.S. Foundation for Boating Safety and Clean Water, provided an overview of the evolving data needs for recreational boaters and how NOAA's navigation services can work for them. BoatU.S. is the largest association of recreational boaters in the country, with over

600,000 members. They have provided governmental affairs and consumer advocacy for over 50 years. BoatU.S. is the largest provider of online and on-water boating education. They use NOAA resources extensively, particularly for incorporating into their BoatU.S. app. The app gets 10,000 new users each month. NOAA services are also used by their towing dispatch, the largest on-water dispatch fleet in the country. BoatU.S. members said they wished NOAA offered an API library for all of their products, buoy data as an API rather than a text file, and would make nowCOAST available in other downloadable formats. There are currently APIs for river stages and water levels, but they refer you to locations of stations, not the data itself. Boaters and towers in Florida would like better mapping of the Bahamas. More air draft information would also be helpful. BoatU.S. has some concern about the push for e-Aids to Navigation and how they will be portrayed on charts. They too would like more information to be delivered through AIS. BoatU.S. would like to get to the point where they can use NOAA's geodetic data, emergency response imaging, and weather data to look at particular harbors to determine if they are good places to be during a hurricane. OCS has been a great help to the recreational boating community and they appreciate the interest and care for recreational boaters they have shown and the products they put out have been vastly improved over what they have seen in the past.

Will Fediw, Industry and Government Affairs, Virginia Maritime Association (VMA), provided an overview on needs for data, products, and services from NOAA's navigation services to support a dynamic and evolving shipping environment. VMA has served as the voice of the port industries in the Commonwealth of Virginia since 1920. They represent over 450 member companies from a full spectrum of maritime logistics-related firms. Yearly, Virginia's ports support $88.4 billion in spending, $27.4 billion in wages for 530,800 jobs, and generate $2.7 billion in state and local taxes. Virginia's maritime industry relies on accurate, real-time data. PORTS is relied on, not just by pilots, but also by economic developers and steamship lines looking at what opportunities can be realized. NOAA navigations services are used for pilotage decision-making, confirming buoy errors, post-storm recovery, and economic development decisions. Beyond PORTS and charts, NOAA's water-borne assets are helpful in heavy weather planning and recovery. The Norfolk harbor channel is authorized and funded to deepen to 55' and the Southern Branch to 45'. USACE's Chief's Report recommended widening Thimble Shoal channel to 1400'. Preconstruction engineering and design for this project is currently underway and dredging is scheduled to begin January 2020. This will allow two-way simultaneous traffic year-round in all but the worst weather for ultra-large container vessels and large naval assets. This will also potentially allow for capesize class bulk carriers to use the channel. Accurate real-time data is crucial for vessels of this size to safely navigate. They are currently modeling 18,000 TEU vessels for the deepened and widened channels, but it's another matter when the vessels actually show up and the pilots have to deal with real-time conditions. In order to facilitate this growth, the Port of Virginia needs a fully-funded federal PORTS that is properly serviced and maintained. Other requests for NOAA products and services include an improved Cape Henry wave buoy, CORMS-vetted PORTS data, consolidated bathymetric data from NOAA and USACE, and a consolidated dashboard for PORTS data.

Susan Monteverde, Vice President for Government Relations, American Association of Port Authorities (AAPA), discussed the challenges and opportunities ports and NOAA face in meeting the needs of the nation's busy waterways. AAPA has represented seaports across the Western Hemisphere since 1912. Facilitating international commerce is a shared goal between the AAPA and NOAA. The U.S. is a maritime nation and water transportation savings are critical to America's global competitiveness in trade. It is imperative that Congress and the public be educated on the importance of investing in the

nation's maritime infrastructure. Twenty-six percent of U.S. GDP is related to maritime commerce. Ports and partners are investing billions every year in waterside and landside infrastructure improvements. Federal investment in seaport-related infrastructure is lagging far behind. NOAA products and services that are essential to the safe and efficient movement of freight include nautical charts, hydrographic surveys of federal navigation channels, PORTS data, and weather services for storm response. AAPA members provided input on their views of NOAA programs, stressing the value of PORTS and nautical charts to their operations, but noting that they focus more on federal channels. Challenges include maintenance of aging systems, updates and upgrades, and new services. These are all restricted by flat budgets. PORTS funding is inconsistent across the country and this can be especially unfair to smaller ports. Reliability is a problem with PORTS, as is the ability to accept and share data from non-PORTS sensors. NOS should expedite the switch from tower to satellite signals. PORTS support staff need to be classified as "essential" government workers. NOAA should identify the future vision of Navigation Services and its cost. Ports need insight into how much PORTS is going to cost in the future so they can build it into their budgets and figure out how to focus on the most important things.

HSRP Q&A

Ann Kinner asked if there is a specific format when putting out safety information through the AIS system and if there is a mechanism for receiving it for someone who does not have an AIS transponder onboard. Capt. Viso said the information comes out in a binary format that requires a receiver that is currently in PPU software and displays it graphically or in text. It is available on an app, but a user would have to have a way to receive it. Capt. Kinner asked how best to go about getting the word out to the small boat fleet that they don't necessarily have to install an expensive AIS transponder, but can get the information when they have cell phone coverage. Mr. Edmonston said he has the app but for most of the country a boater would never need AIS and when he turns AIS on on his chart plotter it blots out the entire screen. Larry Mayer said that beyond the delivery of AIS information is the possibility of two-way transfer of information.

Anne McIntyre asked for perspectives regarding funding and on-going operational support of PORTS funding, as well as operational support examples. Ms. Monteverde said there is a lot of advocacy work going on for PORTs, but AAPA has other priorities as well, such as dredging, infrastructure, and the environment. Those who make the most noise in Washington do get the most attention. Sean Duffy said that the federal maritime pie needs to get bigger so the slices get bigger, otherwise it is taking from one program to fund another. Ms. Monteverde said they have not made much headway in Washington on the issue of federal funding for PORTS. When the President's budget comes out and NOAA puts out their recommendation, maintenance is not included. HSRP should look at whether they think the funding model is consistent and fair. Right now ports are willing to pay for part of it, but if PORTS gets much more expensive it will be a real challenge. Ed Kelly said the National Association of Maritime Organizations will be relaunching its ports coalition and will reach out to APA, AAPA, and other stakeholders. The issue is not just if the port authorities can pay for PORTS, but the system is getting more robust, the cost of moving to more precision navigation-style products in more ports will continue to push the costs up. Some of the biggest users of PORTS are not large commercial operators that port authorities are primarily representing. DoD, recreational boaters, academics, NWS, so many people use the data, but deep sea commercial vessels seem to be the only people paying for it.

Kim Hall asked where the barrier is in moving information over AIS. Mr. Edmonston said there could be potential legal issues. The HSRP could help by defining what kind of data streams should go into AIS. Ed Page said that USCG has to control the data because otherwise it would overwhelm the system, but it's moving in the right direction and more solutions are coming online.

Juliana Blackwell responded to Dr. Abdullah's list and said that NGS is working on many of the items. CO-OPS and NGS are working to make their benchmark data available in one place. The issue with CORS is that at some point you reach a capacity of what you can manage. NOAA has been holding at about 1,800 stations because they have maxed out the personnel and the IT network they have internally. They are working on that but it will take several years based on the resources available. Mr. Edwing said that many of the things Dr. Abdullah mentioned are included in the CO-OPS Strategic Plan and his recommendations are a good validation of those goals.

Mr. Fediw emphasized the value of having both the pre-storm preparedness and post-storm recovery, especially when critical industries like the petrochemical industry and national defense operations are waiting to enter the port. Ms. Monteverde said the value of getting the maritime system up and running after a disaster is an aspect that the HSRP should highlight more. Nicole LeBoeuf said NOAA has been working hard to inform FEMA about their capabilities. They have made significant progress in this area and expect to be more of a player in the future.

Anuj Chopra asked what would be needed to get traffic running at 100% during fog conditions. Capt. Viso said that it would require an overall shift in how the tools are put together to make fog as manageable as it is in European ports. Coordination of technology, shoreside infrastructure, and a regulatory framework would be necessary. Ms. Monteverde said that it is important to isolate where fog is an issue and where it isn't.

Capt. Chopra also asked what AAPA's strategy is for sea level rise. Ms. Monteverde said ports are used to tidal rises and falls and their engineers typically account for sea level rise. A big part of the problem is in the connecting landside infrastructure and power grids, neither of which do ports have any control over. Ed Kelly said that if the ports had addressed this issue with the states prior to Superstorm Sandy they would have had a lot less trauma.

Dave Maune said that the time will come when GPS and GNSS systems will be challenged by adversaries of the United States and asked if the maritime industry has a backup plan in the event that GPS is not available. Kim Hall said they do not currently and the maritime industry is significantly behind in terms of cybersecurity issues.

Sal Rassello said that there are many ports that operate in fog and asked what kind of infrastructure might mitigating this problem. Capt. Viso said it would take better infrastructure coordination between entities. Radar is the least vulnerable to fog, but geographic layout is a major consideration. Dr. Abdullah said that thick fog will affect lidar, since without GPS geolocation you cannot get data from the lidar itself. Good mapping and having an autonomous roadmap similar to Google Maps would be a way forward.

Dr. Abdullah said NOAA should be proud of what OCS has achieved. They are the best performer in federal service in terms of quality of expertise and a represent a very good investment of taxpayer money.

Public Comment

Roger Barlow, National Geospatial Program, U.S. Geological Survey (USGS), addressed large-scale shoreline mapping (1:2400). Current USGS mapping practice is to display shorelines at 1:24,000 scale and NOAA's depiction at the high end is 1:20,000. Lidar is capable of producing data at 1:1200. Users that require larger scales in order to better understand the shoreline include infrastructure and stormwater entities, transportation networks, and power substations located near water. Public safety and emergency responders need accurate local level data and regulatory functions also require larger scale shoreline data, particularly for shellfish and submerged aquatic vegetation. Large scale data can be generalized and brought down to the scale of current charting, but this doesn't work the other way in cartography. Mr. Barlow recommended convening a group of federal mapping folks to talk about standards and processes.

Jon Dasler, David Evans & Associates, commented on NGS' capacity in managing CORS and asked if they are considering regional networks and validation processes to integrate some of the stations managed by others. He also recommended exploring the possibility of extending some VDatum models further inshore.

William Nye commented on the absence of a presentation on the National Charting Plan (NCP) and the new ENC format at this meeting. He noted that there is very little on the S-101 format in the NCP and this should be a large and significant subject considering the scope of its applicability. He was told the S-57 format will be phased out but that NOAA will produce charts in both formats for some time. The NCP is not a very transparent plan and Mr. Nye has still not received fully responsive answers to his inquiries. In the replies he received, NOAA stated paper charts were derived from survey data, and ENCs were in turn derived from paper charts. This convoluted practice was done for years and has only recently been revised – a statement on this matter is missing from the presentations. The exact role and influence of industry is not very transparent and may be channeled through non-U.S. organizations, but it likely had an effect on the NCP. RDML Smith said S-101 will eventually replace S-57 and will have some benefits in terms of the richness of information that is available, significant improvements to the ability to display the information, and a more modern foundation that makes it easier to update the standard with changes in navigation technology. It is currently being issued as a standard and no hydrographic office in the world has a firm plan for transitioning from S-57 to S-101. This transition needs to be coordinated globally by the IMO. It is RDML Smith's intent that NOAA will lead in this international effort, but it is not NOAA's to drive unilaterally. OCS has recognized a number of ways they would like to update NCP and are considering what the update will look like. On the role of industry, NOAA leaves parts of the navigation services value chain to the private sector to accomplish. Discussions with industry provide NOAA with insight on how their products and services would be more useful.

HSRP Planning and Engagement Working Group

Julie Thomas and Dave Maune, P&G Work Group Co-Chairs, reviewed the HSRP Priorities Matrix that will guide the work of the Panel. The matrix is a list of issues that are important to the Panel members and will be addressed by the HSRP in some way, whether in issue papers, included in the letter to the Administrator, webinar sessions, or in-person meeting presentations. The Panel reviewed the 23 items and made further recommendations to refine and clarify the priorities. Several items required reaching out to members or NOS leadership that were not present. Julie Thomas disseminated a revised version of the matrix to the Panel members that included their comments and further discussion would take place on day three of the meeting.

Recap and Day 1 Wrap Up

Chair Saade asked members to provide comments on the day's events. Members agreed that the panels were excellent and helpful in focusing the thinking of the HSRP. Other comments included the need to continue progress on PORTS, the importance of geodetic data, the continued need for interagency coordination, and the public need to be informed of what products and services are available. Delivery of data to vessels is a broad topic that bears looking at via both AIS and other means. The panels of users and agency leaders were the most supportive the HSRP has seen and this is very promising. The problems the HSRP hears about aren't limited to one area and small changes could have tremendous benefits to communities across the country. The discussion of fog is a different problem statement that may cause NOS to think about the services they provide and coalitions they need to assemble in a different way. Ports shutting down for 20% of the time because of fog is big deal with national economic and strategic impacts. It may now be a solvable issue with the right assemblage of precision navigation tools.

Adjournment

The Panel stood in recess at 4:52 p.m.

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Wednesday, March 6, 2019

The meeting was called to order at 9:03 a.m.

Chair Saade and RDML Smith welcomed attendees to the second day of the meeting.

Day 1 Recap – Member Round Robin Discussion

Member comments on day one focused heavily on the issue of fog and reduced visibility. The fog issue should be risk-based rather than a fixed set of rules with risk assessments on actual scenarios. The issue cuts across several HSRP priorities, such as the need for communication between small boats and large vessels and the dependence on GPS/electronic navigation. The issue also goes beyond fog to any obscured or restricted vision capabilities. Data management and getting the right data to the people who use it was also discussed. More time defining groups of users would be helpful in resolving this matter. RDML Smith listed some of the topics he focuses on that are not included on the HSRP priorities matrix, including standardization, service provision, capacity building, and soft power for the nation. National policy issues on how to improve American competitiveness for maritime is not included either. RDML Gallaudet will likely become a principal on an interagency panel for setting national policy for the MTS and he invited the HSRP to advise him on priorities for CMTS. This is an opportunity that is not yet well-tapped.

HSRP Technology Working Group Presentations

Dr. Larry Mayer and CAPT Andy Armstrong, presented on some of the current research activities at NOAA-UNH Joint Hydrographic Center (JHC). Because it was covered at the last meeting and will be covered again at the next, autonomous vessels were not discussed at length, except to say that this summer JHC will be doing some close-quarter surveying where a manned launch would not be possible. JHC has taken delivery of the iXBlue DriX autonomous vehicle and are conducting sea trials with it. The vessel is purpose-built and can go up to speeds of 12 knots without data degradation and has a much longer duration than the C-Worker they currently have. Another major advantage is its sea-keeping ability

- it can operate in any conditions that larger hydrographic ships can work in. This is a potential game-changer and will allow them to work jointly with NOAA ships and dramatically increase the amount of data they can collect in the same time period. JHC is developing tools towards allowing for real autonomy, such as an autonomous mission planner, tools for sensor fusion and application of AI and machine learning, chart-aware navigation, and reactive behavior to avoid obstacles. Adaptive survey planning work is also underway, so that ASVs will be able to adjust their survey pattern and line spacing based on the depth. They have developed the HydrOffice Tool Kit, which is a suite of quality control tools, the most broadly used of these being the Sound Speed Manager which integrates the collection of sound speed profiles in order to allow for travel time-to-depth conversion and transmittal to sonar. JHC is also developing deterministic error analysis tools to identify problems, such as wobbles brought on by a variety of causes.

CUBE (Combined Uncertainty and Bathymetric Estimator) is an error-model based, direct DTM generator that estimates the depth plus a confidence interval directly on each node point of a bathymetric grid. In doing this, the approach provides a mechanism for automatically processing most of the data and produces an estimate of uncertainty associated with each grid node. It is now the standard for data processing. JHC is expanding this to CHRT (CUBE with Hierarchical Resolution Techniques) which allows for variable resolution datasets to be run on parallel processing machines, and they are exploring ways of visualizing this in three dimensions. The ideas of CUBE are very applicable to topo-bathy lidar data, as it has been a powerful discriminator between good and bad data. JHC is taking advantage of the new generation of multibeam sonars and their broader bandwidth to give a picture of the seafloor at different frequencies, providing new dimensions of seafloor characterization. JHC has hired a new faculty member to assist with developing tools to help automate cartography. The Center has focused on incorporating virtual reality and augmented reality into the Chart of the Future effort and have been exploring whether AR or VR will have a role in aiding navigation.

JHC has tested the impact of 12 kHz deepwater multibeam sonar on marine mammals in two locations and will soon be releasing a thesis paper. Nothing in the test undermines their belief that the sonar should not be affecting the marine mammals. The Navy has acknowledged that their mid-frequency sonars have demonstrated an impact on beaked whales, but JHC's multibeam sonars, when analyzed the same way, show no statistical impact on the foraging behavior of sensitive marine mammals.

JHC is playing a role in new technology approaches for the Seabed 2030 effort, including working with Saildrone on a 72' long autonomous sailing vessel that will have an EM-302 deepwater multibeam onboard. This platform should allow for autonomous ocean bathymetry of 6-12 months. The first sea trials should be in summer 2019. Another visualization tool developed at JHC allows users to keep track of the gaps in global bathymetric data. The map also allows users to see what was used to collect the available data and when it was collected.

Ed Saade, Working Group Co-Chair, discussed return on investment and technology transfer from OCS and JHC. Tech transfer from NOAA and the JHC, along with those from DoD and DARPA, has had a profound impact on the way industry is approaching all kinds of applications. NOAA historically has done a poor job presenting all of the benefits their work provides to taxpayers. NOAA stimulates the economy in the U.S. and enables industry to apply these technologies around the world to earn money. NOAA's charting program, along with its industry partners and various R&D initiatives from UNH have combined to be a leading technologies creator and industry has adopted and applied many of these advancements. As RDML Gallaudet has stated: "NOAA's support for a healthy and productive marine environment is fundamental to the growth of the blue economy."

Chair Saade discussed industry applications of several of the developments that Dr. Mayer discussed, including True Heave, CUBE, MBES backscatter, water column compression, and crowdsourcing technologies. A huge amount of data is available in the public domain allowing companies like Fugro to

conduct desktop studies. Chair Saade discussed one such example where, in one evening, Fugro was able to look at the conditions along the entrances to New York Harbor, stitch several layers of information collected over many years, and find routing for power and telecommunication cables and a routing for a heating oil pipeline. The earlier datasets were very noisy, but thanks to the development of CUBE and True Heave the quality is much better.

Artificial intelligence and big data rely on one another. As the resolution of AUVs and ASVs improves, these vessels will collect the data that will be the basis for AI. Many of the recent developments have come out of DoD and DARPA, particularly autonomous airborne vessels. A new generation of hydrographic lidar has shown major progress in terms of data density, the speed of data collection, and the number of staff members needed in the field in order to collect the data. Autonomous vessels will have billions of dollars in impact for industry. Many other UNH applications will have several million dollars' impact in revenue for businesses and for developing offshore infrastructure.

Lindsay Gee, Technology Working Group Co-Chair, discussed his experience in the early days of GPS development and how industry benefited greatly early on but now the benefits have reached all of the population and improved their lives in many ways. Autonomous technologies are evolving and NOAA should be working with USCG to ensure that the operation of autonomous vessels will be possible within regulations. Hopefully, the R&D at UNH can assist in accomplishing this. Tech transfer from the JHC has been aided by the industrial partnership established early on. These partnerships include hardware/software developers and service providers, all of which have different requirements and need the technology at different stages of R&D. There's no doubt the JHC has been a success and a great benefit to industry, but it is important that it continue to evolve and improve the transfer processes because some of its technologies never get out. The HydrOffice Sound Speed Manager is available now through an open source and is a very successful tool used by lots of people, but it is surprising that it was not picked up by industry. Oftentimes when technology is transferred to industry it is a one-off transfer. The technologies need to be actively managed and further research incorporated.

Chair Saade listed topics for the Technology Working Group for either the next HSRP meeting or through webinars: AUV updates, Seabed 2030 update, and how to get data on charts.

HSRP Q&A

Co-Chair Thomas asked what stage the CUBE software development is at. Dr. Mayer said that it is in the public domain. JHC develops software to the prototype stage and then 45 industrial partners have exclusive rights to it, a subset of which will take it and make it part of their products. Contacting the manufacturers is the best way to find out where in their product development process it is. Academic institutions can get access to the research code base with restrictions.

Ed Kelly asked how much work NOAA does collaboratively with companies like Google or international organizations. RDML Smith said it happens in a variety of ways, such as international conferences or meetings with hydrographic colleagues several times a year. NOAA is working with Norway on next generation dissemination of services – they are one of two primary organizations worldwide that coordinate the dissemination of ENCs. Dr. Mayer said that what they do academically involves a lot of international collaboration which is then fed back to their NOAA sponsors. Lindsay Gee said that, from an industry point of view, there is a natural collaboration from industry because R&D spreads out and is used internationally. Ed Kelly followed up by asking if NOAA is reaching outside of the maritime industrial framework in looking for partners, such as looking at what others have achieved with autonomous vehicles. Dr. Mayer said that the work JHC is doing in artificial intelligence uses algorithms and techniques from outside of the hydrographic world. There are many unique aspects to the maritime domain that they are exploring how applicable these other approaches can be. RDML Smith said that the company they have contracted to convert manned launches to optionally manned began its work in

automation clearing roadside bombs, and brings a different set of technological heritage to bear in this context.

Lindsay Gee asked about the USCG rules and regulations for using autonomous systems and if there is collaboration with NOAA looking at unmanned survey platforms. RDML Smith said for their missions they treat unmanned vessels as under the supervision of NOAA people, typically within line of sight. The Coast Guard does not yet have a robust set of rules on that. NOAA discusses this with USCG at the CMTS, but any additional input from the HSRP to inspire more progress would probably be helpful. Dr. Mayer said that JHC treats them as piloted vehicles. The U.K. is taking a very serious look at ASV guidelines and JHC has stayed tied in to those discussions.

Anuj Chopra said every time a hurricane comes into the Gulf of Mexico and its waterways, the recovery effort is slowed down because of the survey of the rivers. He asked if NOAA or its contractors have looked into having a mother ship with four autonomous vessels do a single pass up the waterways to speed up the effort. Chair Saade said yes, Fugro is experimenting with this on paper, at least. Others are also looking at it, particularly manufacturers of drones.

Ann Kinner asked if the significant differences between the Navy's and JHC's sonar results on marine mammals had to do with the differences in depths at which the soundings were tested. Dr. Mayer said that the response of the marine mammals to the Navy sonar has been consistent everywhere. Theirs is a much more powerful sonar, which puts out a tone for seconds as opposed to milliseconds.

HSRP Special Session: Hot Topics and Updates

Tony LaVoi, NOAA Geospatial Information Officer, and Chief, Integrated Information Services Division, Office for Coastal Management, NOS, discussed the Geospatial Data Act (GDA) and said there are clearly connections between what the HSRP cares about and what could potentially be within the purview of the GDA. The federal geospatial community is a relatively insular community, but the GDA may provide a mechanism for the inclusion of other voices. NOAA and the Department of Commerce are leaders within the Federal Geographic Data Committee (FGDC), which gives the HSRP a voice on topics of interest. The GDA was originally introduced in 2015 and eventually signed into law in 2018. It creates requirements for compliance where compliance had previously been voluntary in nature, such as establishing requirements for National Spatial Data Infrastructure and NSDI strategic plans, National Geospatial Data Asset data themes, geospatial data standards, GeoPlatform, and Covered Agency planning and reporting requirements. The geospatial community is not well-understood, particularly its return on investment and the impact to the economy – the GDA may bring more attention to this. The GDA codifies and strengthens the National Geospatial Advisory Committee (NGAC) and gives it a much more active role. Mr. LaVoi invited HSRP members to attend the NGAC public meetings in March and June and provide feedback during the NSDI Leaders Forum in April.

There is a lot of geospatial activity that is happening in the coastal and marine area that is not being highlighted. The GDA presents an opportunity to connect NOAA's mission, programs, and impact to HSRP through things like the NGDA themes, agency geospatial plans, and ROI. Additional reporting for federal agencies will provide more Congressional exposure to geospatial data and systems. The GDA's emphasis on data and metadata standards would benefit from HSRP's input on guidance on the front end. The Act also provides connections to other government data initiatives, like the Federal Data Strategy, the Evidence Act, and artificial intelligence initiatives.

Allison Allen, Chief, Marine, Tropical, and Tsunami Services Branch, NOAA National Weather Service, discussed next generation marine weather services. There are a number of challenges at sea, not just for mariners but also for marine forecasters. These include the amount of shipping going on, the number of passenger vessels, and severe weather, etc. Offshore high seas continue to be a challenge for

forecasting because NWS does not have as many observations in those locations as along the coast. The Ocean Prediction Center and the Tropical Analysis and Forecast Branch handle high seas forecasts. The National Weather Service's Marine Service Program Teams' goal is to ensure that all marine users meet their safety and economic needs through ready access to accurate, timely, and easily understood coastal/marine forecasts, warnings, and other products. NWS is looking to expand their National Digital Forecast Database to allow for point-and-click forecasts of marine weather. NWS is committed to its role in precision navigation, marine forecasts, waves, and visibility. One thing that has come with the advent of precision navigation is it has opened the door for increasing the efficiency between the two sides of NOAA. NWS is looking forward to replicating the Marine Channel Forecast pilot project approach in other places.

The S-412 vector and gridded product specification will allow NWS to manage the content, structure, and metadata for marine weather so it can be disseminated through ECDIS, which currently does not cover marine weather. This is a large undertaking that will be broken into three steps with different product specifications: weather hazards, weather conditions, and weather observations. NWS is also continuing to look at collision avoidance, purchasing additional AIS systems to be able to observe mariner behavior. Using AIS, NWS is looking at how vessels behave in the Gulf Stream and are finding that in cold weather outbreaks even tankers have to slow down, which creates safety and economic concerns. NWS is in the process of trying to improve the Global Real-Time Ocean Forecast System with additional wind and current information to be able to better forecast hazards.

In response to the *El Faro* incident, National Hurricane Center has agreed to adjust its forecast and advisory product to be able to mention not just the time of the next full advisory but also the next intermediate advisory. The National Hurricane Forecast Improvement Program is doing many things that will improve upon the recommendations in the *El Faro* report, including looking at improving model forecast skill for track and intensity by 50% and reducing the uncertainty for rapid intensification by 50%. They will also be looking at whether graphical products can be delivered by FTPmail and are getting input on which of those products would be most valuable.

NWS has decoupled storm surge information from the hurricane forecasts, recognizing that hurricane forecasts are strictly dependent on wind and that people were letting their guard down on low category storms with high impact storm surge. The decoupling has led to an imbalance in the level of service between tropical and non-tropical storm surge. NWS is working to bridge that gap now and is partnering with the emergency management community. NWS has a lot of ongoing work in an effort to simplify warning products. They currently have over a hundred Watch, Warning, and Advisory products that they are consolidating as well as looking into whether they need to re-envision the entire program.

HSRP Q&A

Ann Kinner asked how the GDA ties to the National Geospatial-Intelligence Agency (NGS) and about coordination between NOAA and NGA. RDML Smith said that NGA's charting responsibilities are primarily for the military. Their charts' availability over the last few years has been a response to the honoring of data use agreements with other nations. The scope of what is publicly available from NGA has shrunk dramatically and much of what is available is not well-maintained. RDML Smith would be interested in the Panel members' thoughts on national policy for how they should be coordinating charting responsibilities across the federal government. Mr. LaVoi said that when the FGDC was created most of DoD and almost all of the intelligence community was left out. Over the last five years there has been much more active involvement, especially from NGA.

RDML Smith said he is proud of the geospatial community for the way that they have traditionally approached development with open data and coordinated and standards-based work. He asked how NOS could get on the blue ribbon track early in this effort and have an opportunity to show leadership. Mr.

LaVoi said that the terrestrial members of the FGDC have little appreciation for this community's sophistication and maturation, both from a technology and standards perspective and from their engagement with the public-private sector. There is a good story to tell and he encouraged that marine and coastal community to promote itself.

Gary Thompson asked if CORS data is being used in weather forecasting. Ms. Allen was not aware of it being actively used in any of the marine forecasts.

Sal Rassello said that Carnival Cruise Lines shares its ships' daily observations every three hours with NWS and he asked if Ms. Allen has access to this data. Ms. Allen said that through the VOS program they have access to some ship observation data but they are interested in increasing the volume. Capt. Rassello said that the proposal for S-412 is very good and asked if NWS had discussed it with the manufacturers. Joe Sienkiewicz, NWS Ocean Prediction Center, said that they are aware of the challenges of having a different type of data set displayable in ECDIS and this has matter been discussed internally. They do not yet have a solution for how it will be done, but they are well aware that they cannot cover or distort the underlying information. Capt. Rassello asked how much bandwidth it would require if it is done via satellite. Mr. Sienkiewicz said that the systems NWS is using now are antiquated and need to be updated. WMO and IMO also recognize that the information needs to be in more modern formats and perhaps multiple formats.

Ed Page asked about ice forecasting and information and if NWS felt comfortable that they will be able to provide the kind of detail that is needed for increased traffic in the Arctic. Mr. Sienkiewicz said the agency is in the process of moving the NOAA component of the National Ice Center into NWS's Ocean Prediction Center. The National Centers for Environmental Prediction is working on building the modeling systems in order to move forward having ocean coupled with waves and ice, which is very challenging. There is an international push to improved observing systems at higher latitudes, primarily by satellites.

RDML Smith said NOAA's navigation services still think they need to control how the user uses the information and how they look at it. What is really needed is consistent, high-quality, and coordinated information worldwide and developers will figure out how to display it. NOAA should step away from the portrayal part in order to drastically accelerate the provision of these services. Mr. Sienkiewicz said not utilizing the standards on the *El Faro* or having a third party source of information may have been a contributing factor to the decision process of where the vessel was. Anuj Chopra said that new technology and updating of vessels is required and if a vessel operator does not do that it should not hold the rest back.

Capt. Rassello asked why NOAA does not include recommended routes to help operators avoid severe weather. Mr. Sienkiewicz said that beyond being a liability concern, it is also outside their mission. Mr. Page noted that each ship has different particulars that would make voyage planning out of NOAA's scope; the agency should just provide the information users need.

Public Comment

William Nye said that certain NGA charts are declassified and provided to NOAA. This is not a completely transparent process and he directed NOAA and the HSRP to the inquiries he noted on the previous day. RDML Smith said he has not had a chance to review the inquiries but has directed staff to pull them up and make sure Mr. Nye gets an answer.

Dr. Qassim Abdullah made a few suggestions in response to the meeting's discussions. The current state of autonomous vehicles, GIS tools, and the geospatial communities can serve maritime activities. Where there is good bathy and GIS information, we should be able to steer around fixed facilities, though this

doesn't solve the problem of small craft not complying in channels. Virtual and augmented reality will be helpful in the evolution of navigating in restricted visibility. As a matter of maritime navigation resiliency, the issue of GPS vulnerability needs to be considered seriously. The least that could be done is to ensure that people are using GNSS, which would provide additional sources if GPS goes down. A new concept of operation is probably needed for the maritime community to highlight the vulnerabilities of GPS and mitigation strategies. Juliana Blackwell said that the Space-based Positioning, Navigation, and Timing Advisory Board has been discussing backups to GPS and the utilization of other countries' navigation satellite systems. This issue is much larger than NOAA, but how the maritime industry plans for GPS failure is within the agency's navigation domain.

Jon Dasler, David Evans & Associates, said that you can use radar and AIS in fog, but the issue of small vessels that don't have AIS remains the problem. What is needed is a system that not only incorporates radar and AIS on vessels but also observation systems that are focused on small vessels. Airplanes can do instrument landings because they have requirements for transponders, pilots know where things are, and there are traffic controllers coordinating. This needs to be expanded to the maritime community.

David Miller, Fugro, said automated systems are advancing rapidly, but the real economic benefit will come from over-the-horizon operations and force multiplication. He believed that the technology will soon get to this point but not be implementable because of the regulatory regime. The HSRP should not lose sight of that and should push for regulations that facilitate technologies that are being developed.

NOS Office Directors' Updates

Rear Admiral Shepard M. Smith, Director, Office of Coast Survey, provided some examples of hurricane supplemental survey projects, updates to nautical charting, and an overview of OCS' international activities. OCS bundled the hurricane supplemental survey projects with their regular appropriated funds for the year to carry out some big projects, including shallow water work off the Florida Keys and in Port Lavaca, Texas, and surveys in Tampa Bay, Florida, to support an increase in vessel traffic. The only block of sustained capability that OCS maintained during the recent government shutdown was to be able to update the charts for reported Notices to Mariners. The normal QA process was not in effect and new surveys were not being done. Contractors continued working without pay. OCS had a plan it had rehearsed with one-week shutdowns, but sustaining the program for several weeks was beyond the plan. Raster updates were suspended, but ENCs kept going out on a weekly basis at a high level of service. As a result of the shutdown, the chart application backlog increased by about 150%. OCS has retained the suspension of raster charts since the shutdown until they could catch up the ENCs.

Channel tabulations have fallen largely out of use and OCS decided to stop creating them, concentrating instead on taking the same USACE condition surveys and making better ENCs that can be updated and distributed quickly. Standardizing depth presentation on these products will improve data consistency and overall safety. Thirteen new ENCs were applied to the chart from surveys in the Etolin Strait off the western coast of Alaska. This is an important area to chart because there are very few refuges in western Alaska. New York Harbor is being used as a testbed for a new way of databasing OCS' bathymetry, one that will be able to pull together many surveys of different vintages and get them chart-ready in a single coherent set. RDML Smith showed an example from Puget Sound of the type of automated contouring OCS will be using for high-definition charts in deep draft channels.

Over the past ten years, NOAA has been an international leader in modernizing digital versions of services like Coast Pilot, light lists, and tide and current tables. OCS has representation in several IHO bodies. NOAA and OCS has a lot of international involvement in both leadership and standards organizations, including the ISO Council and working groups, IHO Regional Hydrographic Commissions, and the UN-GGIM Working Group on Marine Geospatial Information. To the extent that

the HSRP believes that NOAA needs to marshal more leadership on international activities they have some mechanisms to do so.

Julie Blackwell, Director, National Geodetic Survey, provided the update on NGS' activities. Key activities in the National Spatial Reference System (NSRS) modernization effort include work on the Pacific GRAV-D survey in 2019 covering Hawaii and American Samoa, development and publication of a new Least Squares adjustment model for the OPUS tool, a new Blueprint for 2022 document which will be released in draft form by May 2019, and development of VERTCON 3.0 which updates a tool that converts between NAVD 88 and NGVD 29. GRAV-D collection is over 75% complete. Mainland Alaska was completed in FY18, though the western Aleutians remain to be done. About half of Hawaii was completed before the plane had to go in for scheduled maintenance. Once it is available and Hawaii is complete, they will move on to American Samoa and continue CONUS.

NGS' revised Strategic Plan for FY19-23 updates the 10-year plan. It does not contain many changes, but one completed item is the establishment and implementation of their Project Management System. This has helped manage resources, make sure things are done in the right order, and improved accountability. NGS has also established a Regional Advisor program which gives them a larger role in regional outreach. NGS is now looking at how they can be more efficient with their facilities and other opportunities that may come out of the NOAA-managed facility review currently underway.

NGS has been collecting information on bench marks in their database that they don't have accurate coordinates for. The 2018 GPS on Bench Marks Campaign released a list of about 5,700 marks they were seeking data on and received ~3,800 4+ hour observations on ~2,600 unique marks. Seventy-three percent of the submissions came from state agencies and 13% from the private sector. Many university students contributed. This information will be incorporated into the new hybrid geoid model that will give users a much more accurate vertical component to their GPS data prior to the release of NAPGD2022.

Industry had been requesting that NOAA share alpha and beta versions of NSRS products so they can see how they can integrate it into their software packages. As a result, several products are now available to stakeholders for their use and feedback, including the beta Mark Recovery Form, GEOID API, JSON format, among others. These are all available on the NGS website.

NGS went through a large reprocessing effort, called Multi-Year CORS Solution 2, to analyze 23 years of CORS data that they then connected to the International Terrestrial Reference Frame. The results are available in beta and show horizontal and vertical changes along with new coordinates and velocities. They have more stations than they have in the past, which densifies the network, and a better understanding of how those locations are changing over time. NGS conducted remote sensing work in a variety of formats in the three areas impacted by Hurricanes Irma, Harvey, and Maria and this information will be applied to the National Shoreline product. The data is primarily being used to update the nautical chart but have many other purposes, including storm surge and inundation modeling.

Ms. Blackwell invited attendees to the NGS 2019 Geospatial Summit, May 6-7 in Silver Spring, Maryland, which will include much more information on the NSRS modernization effort. She requested recommendations for case studies on how replacing NAD 83 and NAVD 88 will impact the community.

Rich Edwing, Director, Center for Operational Oceanographic Products and Services, provided an update on CO-OPS' activities under their new Strategic Plan. The three goals of the Strategic Plan are: (1) User Driven Products and Services; (2) Oceanographic Observing and Modeling; and (3) Organizational Performance. Two major projects under Goal 1 are updating the National Tidal Datum Epoch (NTDE) and the International Great Lakes Datum (IGLD). The two epochs have come around at about the same time and creates a lot of additional work for CO-OPS. NTDE provides a national consistent tidal datum network by accounting for seasonal and apparent environmental trends in sea level that affect the

accuracy of tidal datums. Given that sea levels are consistently trending upwards, CO-OPS may reconsider where in the timeline they establish mean low water or do five-year updates. CO-OPS would appreciate HSRP's input on this. IGLD updates the Great Lakes' datums to account for vertical movement due to glacial isostatic adjustment. It is a bilateral effort with Canada and, unlike the NTDE, the IGLD requires a lot of field work from NGS and CO-OPS.

CO-OPS is working on modernizing their website to display information in a more uniform way and make it more compatible with mobile devices. New plots will integrate real-time observations, predictions, and forecast information where available. More metadata will also be available for tidal current data. These website improvements will also help with precision navigation data dissemination which will feed into dynamic under keel clearance systems, PPUs and electronic navigation systems, among others. CO-OPS will be integrating QuickLook into the Coastal Inundation Dashboard so that it is always available. The dashboard pulls together three spectrums of data: historic data, real-time data, and forecast data. Users will soon be able to customize their own webpages in the dashboard. CO-OPS is working to ensure they are consistent with NWS terminology, graphics, and colors.

Efforts underway related to Goal 2 include transitioning away from the acoustic sensors as the primary water level sensors to micro waves. Micro Wave Water Level (MWWL) sensors have been installed at 69 out of 152 NWLON stations with 39 fully transitioned. The project is expected to be completed by 2028. CO-OPS is trying to leverage and integrate GNSS technology into their systems for a number of reasons; benefits include continuously monitoring water level sensor stability, realizing potential efficiencies in bench mark maintenance protocols, strengthening station datum connections to NSRS, and improving the ability to determine land motion. Next on the horizon is exploring whether GNSS can be used as a water level sensor.

114 NWLON stations were in the paths of Hurricanes Harvey, Maria, and Irma. All of the stations have been assessed and repairs completed. Three stations (Rockport, Mayaguez, and Charlotte Amalie) were destroyed and will be rebuilt in FY19 – temporary stations have been installed in the interim in order to minimize data gaps. CO-OPS received an extra $1.5 million in FY19 to rebuild stations at Dauphin Island, Port Moller, and Ogdensburg.

A CO-OPS modeling plan should be released in the coming months. Over the next few years their modeling efforts will focus on coupling with the Harmful Algal Bloom (HAB) Models with modules included that can forecast hypoxia, real-time data assimilation, ice forecasting in Lake Erie and Cook Inlet, and coupling hydrodynamic models and the National Water Model to improve total water level forecasting. Mr. Edwing suggested a possible session on the NOAA's Total Water Initiative at a future HSRP meeting.

HSRP Q&A

Chair Saade asked if the tidal epoch updates are in sync with the rest of the world. Mr. Edwing said they do not try to be in sync with each other, because that's not really needed. They are more concerned that the gauges contributing to the Sea Level Archive are to the same standard.

Mr. Thompson asked when the CORS data sheets will be updated. Ms. Blackwell said the new coordinates based on the multi-year solution are about ready. NGS is waiting to see if they can pair it with the new Hybrid GEOID model so that when they update OPUS everything can be pulled together. Galen Scott estimated it would be around June.

CAPT Armstrong asked about the surprisingly large transformation uncertainties with the VDatum tool and if GRAV-D would reduce those uncertainties. Ms. Blackwell said that every piece of data that gets input brings its uncertainty with it and older information has higher numbers. Even after GRAV-D has

been integrated, it will still have data components that need to be tied to that. Reducing the uncertainty will require new observations and tying those together with the new geopotential datum. Mr. Edwing said that they initially built VDatum to meet hydrographic specifications which are relatively large, now they are in the process of going back and doing additional tide gauging and GNSS connections to reduce the uncertainty.

Sean Duffy said HABs are a major issue in Louisiana and it could be a topic for the next HSRP meeting in New Orleans.

Gary Thomas thanked the agency for keeping NOAA's online products available during the government shutdown, which hasn't happened in previous shutdowns. Ms. Blackwell said that even though they are considered mission essential in NOAA's Continuity of Operations Plan, the decisions about the website are made at a higher level. They did have banners on NGS webpages stating that the data that was being input and fed out was not being validated in any way.

Adjournment

The Panel stood in recess at 2:24 p.m.

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Thursday, March 7, 2019

The meeting was called to order at 9:00 a.m.

Chair Saade and RDML Smith welcomed attendees to the third day of the meeting.

Day 2 Recap – Member Round Robin Discussion

Chair Saade called for the HSRP members' comments on the previous day's proceedings. Comments included NOAA needing to be the tip of the spear on the issue of reduced visibility and that the regulatory environment for new technology (particularly autonomous) is not clear in the U.S. A recurrent theme was that high-resolution data has value if it is available, curated, and open. The solutions to navigating in fog would be the same as for under keel clearance or air draft – high-resolution bathymetry, real-time observations for weather and oceanography, etc. Bringing fog into this helps to make the case for why these services are necessary. Another point was that infrastructure is much more that physical infrastructure. The datasets NOS provides can be used to enhance the way physical infrastructure get built quicker, safer, and less expensively. HSRP needs to make that connection. There may be large sectors of industry that is unaware of the advancements coming out of the JHC and they need to find a way to make it known.

CAPT Page requested an educational presentation on the boom in LNG shipping and the potential hazards and associated risk mitigating measures in place. Capt. Rassello agreed that LNG is coming very aggressively to U.S. ports and they are not prepared. Capt. Chopra recommended having the USCG Center of Excellence in Port Arthur give the presentation. Kim Hall said informational briefings are helpful, but it is important that the Panel focus on how the topic relates to its particular scope.

Anuj Chopra suggested areas for the Panel to focus its attention in the future, which included environmental monitoring related to emissions, improving predictive models methodology, more useful dashboards, and identifying challenges other agencies have with their systems (such as USACE's PSIX user portal). On a global scale, the suicide rate of seafarers on ships is more than 200% of the average, in

some regions as much as 700%. There is a worldwide initiative on the well-being of seafarers and would be a good topic for CMTS. Better coordination is needed to address bottlenecks at the ports to improve the logistic chain at the interagency level as larger ships come in.

The Panel discussed possible topics for the next HRSP meeting. These included emergency management, datums, LNG, HABs, the reopening of the Bonnet Carre Spillway, sea level rise, fog, federal funding for maintaining the Mississippi River, Corpus Christi Shipping Channel oil and gas activity and the challenges for the ships there, subsidence, and charting beyond U.S. waters (Mexico, Bahamas, and South Pacific).

HSRP Special Session: Addressing SLR Challenges and Data from NOAA's Navigation Services

Julie Thomas, HSRP Co-Chair, and Audra Luscher, CO-OPS, moderated the panel. **Mark Osler, Senior Advisor, Coastal Inundation and Resilience Sciences, NOS**, introduced the session focusing on the changing inundation risks from sea level rise and the critical observations and data needed to understand the impacts on communities, navigation services, and the constraints of the current planning system. Mr. Osler discussed NOAA facilities, science needs around sea level rise, and how this all leads to decision support and the ability to raise capacity at the ground level. NOAA has many assets along the coast, which serve as hubs for their science, service, and stewardship missions. The agency will be looking at the nature of these assets, their vulnerability to sea level rise and coastal storms, and their own need for clarity around how their place-based missions are and are not strictly water-dependent. NOAA is in the process of directing research priority towards a vision for a regional and local outlook and even forecast of local water levels. Coastal resilience is an applied science; modeling and observations are of little value if they are not put in direct service of decision makers and empowering them to make choices that reduce risk. NOAA is working to better leverage data across agencies, notably through the Digital Coast partnership. NOAA needs to keep pace with federal agencies, local communities, and new partners that are installing their own monitoring networks and contributing information on changes in water level. NOAA is convening discussions around consistency related to the mapping of coastal inundation and sea level rise. This continues to be a challenge as new products on coastal sea level rise are appearing almost weekly. He posed two questions to the HSRP for their consideration: (1) How will advances in observation and measurement technology evolve and become interwoven with decision making? And (2) How does the HSRP envision the role of public-private partnerships in the future of NOAA delivering weather, water, and climate information services?

Dr. William Sweet, Oceanographer, CO-OPS, discussed the Fourth National Climate Assessment (NCA4), a comprehensive and authoritative report on climate change and its impact in the U.S. Global mean sea level has risen by about 16-21 cm since 1900, with about 7 cm of that occurring since 1993. The rate of rise since 1900 is faster than during any preceding century in at least 2,800 years, in large part attributable to anthropogenic warming. Ice melt is becoming a greater component to the overall rise. Rise is not uniform across the globe. Historical trends are not considered future guidance for risk planning purposes, because they are not expected to replicate themselves. As sea level has increased relative to fixed elevation, we are starting to see an accelerated trend in annual high tide flood instances – so even though local sea level rise may not be obviously accelerating, impacts are and will become chronic rather quickly. NOAA has developed sea level rise scenarios for the U.S. to give some guidance with probabilistic projections as to what continued high emissions (RCP8.5) or lower (RCP4.5) might be, with outcomes spanning between .5 and one meter global sea level rise by the end of 2100 as an intermediate scenario. Under this scenario, the relative change will be much higher in some local areas. With an average of about .35 meters of local sea level rise (since 2000), coastal flooding triggering NOAA coastal flood warnings will increase 25-fold between 2040 and 2060 under the intermediate and intermediate low scenarios. This will lead to a big disruption to the supply chain coming out of ports. There are many components affecting local flood risk, but sea levels have a very clear signal-to-noise ratio. Variability

doesn't really matter at this point, and sea level rise in the coming decades will be enough to cause disruptions more places more often.

Dr. Jack Eggleston, Hydrologist and Chief, Hydrologic Remote Sensing Branch, Water Resources Mission Area, U.S. Geological Survey, discussed USGC studies of how sea level rise and vertical land motion/subsidence affect the nation's land, water, and coastal resources, with relation to NOAA's data. USGS' Water Mission Area is the largest of the agency's seven mission areas and their work includes hydrologic monitoring and modeling at sites across the country. They use NOS elevation, geodetic, and tidal data. They rely on the NSRS for all of their monitoring sites. Tide and current data is used on their hydrodynamic models. Many of their groundwater models have boundaries set by the tidal data. Examples of the USGS' use of NOS data include their land subsidence studies, studies on how urban stormwater systems will be affected by sea level rise, how atmospheric and tidal pressures are affecting aquifer thickness and hence land surface vertical position. Other USGS mission areas that use NOS data include the Ecosystems Mission Area, who use seafloor bathymetry data for mission planning, tide data in their studies of fish movement, and the Florida Reef Tract maps to study stony coral tissue loss disease. The USGS Core Science Systems Mission Area collaborates extensively with NOS through the Interagency Working Group on Ocean and Coastal Mapping and the 3D Elevation Program, among other mapping and data collection partnerships. USGS' coastal hydrodynamic and sediment transport models are based on NOS data and are used to identify and evaluate sea level rise, spatial variations, and extreme coastal storm events and trends, as well as quantifying coastal hazards and assessing bathymetric changes over time. USGS relies heavily on NOS data, particularly geodetic data, which is a fundamental activity that doesn't often get public attention but is foundational for supporting an ecosystem of other science, commercial, and public activity. Dr. Eggleston suggested repeating the study of land surface motion, which is something USGS can't do but NGS has the data and expertise to do and would be very valuable. Looking at land surface motion across the U.S. should involve NASA as well as USGS and NOAA as a multiagency collaboration. Artificial intelligence and image analysis could be put to many uses such as the determination of HABs over wide areas, river ice conditions, and fog cover. To get to these variable requires a lot of compilation of data and analysis using new methods and platforms that are now available.

Dr. Brian K. Batten, CFM, Senior Coastal Scientist/Senior Associate, Dewberry, discussed a range of projects that highlight the benefits of NOAA products, as well as opportunities for future advancement. Higher levels of uncertainty lead to lower levels of agreement and greater confusion for the public. The scenarios included in the National Climate Assessments provide a great source of authoritative information across a range of federal agencies and give stakeholders a higher comfort level. The inclusion of probabilities assigned to the scenarios in the 2017 update is great and something Dewberry's partners and clients want to know. As you start to work with communities, this can translate into different approaches in how you start to develop information to help people realize what the implications are for them in the short and long terms and to enable some planning and decision making. Sea level rise and storm surge flooding get a lot of attention as threats to coastal communities, but heavy rainfall is starting to be recognized as a serious concern. Many coastal communities' stormwater systems were designed 50-80 years ago to levels just above then-high tide. Water levels have risen and now outlets are blocked on a regular basis and rainfall can't get out. Communities are seeing increased stormwater flooding and issues because of this and it is very expensive to raise the infrastructure. Dr. Batten discussed the example of Virginia Beach, VA, a recipient of one of NOAA's Coastal Resilience Grants, and what that additional money has allowed them to do. Through historical rainfall analysis, they were able to determine with moderate/high confidence that frequency and intensity of rainfall are increasing. Future rainfall projections show that the Atlas 14 guidance from NWS is underestimating local design rainfall by 7-10%. Future projections support increases of 5% for the intermediate scenario to 24-27% in the high scenario by 2060. Historical trends suggest a 20% increase in standard given a 40-year design horizon. The City of Virginia Beach has taken this information and incorporated it into a draft design guidance document that is currently going through an approval process. In areas where there is nonstationarity, Atlas 14 should

warn users to use caution. FEMA uses water level data to inform recovery resource allocation and Dewberry uses it primarily to validate their storm surge models. One of the challenges Dewberry encounters when pulling APIs or gauge tables to collect data and metadata is that federal agencies use different standards, different datums, and different time references. Gauge sourcing complicates the process. Dewberry would like NOS would apply VDatum to all their gauges and just report NAVD, with the caveat of its limitations. Dr. Batten recommendations that NOAA quantify and publish data on the acceleration of sea level rise and improve their guidance to help communities. He also recommended updating Atlas 14, enabling the download of multiple water level station records, and moving towards one federal data standard and access portal.

Rear Admiral Ann C. Phillips, USN (ret.), Special Assistant to the Governor for Coastal Adaptation and Protection, State of Virginia, discussed Virginia's objectives and plans to prepare for the impacts of extreme weather, natural hazards, sea level rise, and recurrent flooding, and the ongoing data needs at the regional and state level to ensure the best possible scientific support for decision makers. Virginia has about 10,000 miles of tidally-influenced coastline and is attempting to coordinate across the eight coastal planning district commissions a plan for how residents can prepare themselves for these events. The state is experiencing sea level rise at an accelerated rate because it is also coping with land subsidence as part of their challenge. Weather forecasts for the five weather stations that impact Virginia all report differently, displaying portions of the state, which makes coordinating statewide perspective difficult. The state is going to need integrated water level projections over time as they try to pull in riverine and tidal impacts. Part of the challenge with having several federal entities in the region is working with agencies that are not in sync with each other. Virginia is a big supporter of continued improvements to the National Water Model and the inclusion of estuary and coastal systems to get a broader projected understanding of what's in the state's future. Atlas 14 needs to be updated. RDML Phillips is supposed to be focused on the coast but is continually running into the issue of rainfall and the need for additional rainfall data and understanding at a user community level across the state. Anything being done to integrate estuarine models into coastal system models is of great interest. The challenge of sea level rise scenario planning curves is in explaining to users how they can best interpret the data and use it at a basic planning level, what it means region-by-region, and what kind of recommendations NOAA makes. NOAA and USACE curves being different also presents challenges because the state works with USACE and their curves are lower than NOAA's. Virginia will be behind the rate of change if they continue planning to the lower curves. Any way the two can be pulled together would be of great value at the user level.

HSRP Q&A

Dave Maune asked what USGS would like to see NOAA do that they are not currently doing. Dr. Eggleston recommended NGS do a review of historic bench mark data, as this would be very helpful for understanding trends of land vertical motion and subsidence. They could also do more real-time or near real-time analysis of remote sensing data to look at important variable such as HABs, river ice conditions, or perhaps fog cover.

Gary Thompson agreed that having all of the federal agencies' gauge data in the same format would be an improvement.

Dave Maune asked if USGS is doing a nationwide assessment on subsidence. Dr. Eggleston said it is a favorite current topic at USGS and new satellite data will be coming out that will make it much easier to produce a national land surface vertical motion dataset. There are internal USGS discussions that will likely broaden out to include NGS and NASA soon. Dr. Smith said that when they did the sea level rise scenarios for the U.S. using the network of tide gauges in a statistical model, they were able to develop a one degree gridded basis estimate of vertical land motion. This is a good first order estimate, particularly for areas that do not need a high level of granularity.

Sean Duffy said the National Centers for Environmental Information reports that everything east of the Mississippi River is wetter than it has been for over 120 years. Rainfall is making life on the Mississippi River very challenging, as it is elsewhere. He asked if there is any data showing whether this is the new norm or a passing trend. Dr. Batten said that the work they did was in the context of the City of Virginia Beach. What they saw there is that rainfall has been increasing, but he couldn't speak to what is happening nationwide, though there are some indicators in the NCA. Dr. Sweet said NCEI provides similar information to Atlas 14 but in a projected mode, so there is an opportunity there to start trying to combine the stationary snapshot of the historical rainfall characteristics with projected, and doing monitoring along the way to statistically keep better score. Mr. Duffy said that the standard for what qualifies as a 100-year or 500-year event needs to be updated.

Nicole LeBoeuf asked the panel what they thought the biggest social, economic, and policy gaps are that NOAA could attend to. RDML Phillips said education is needed for inexperienced planners in small counties with very small staffs and budgets who don't know how to interpret or prepare for these circumstances. This is an area where RISAs (Regional Integrated Sciences and Assessments) would be helpful. Dr. Batten said NOAA Coastal Grant Programs and trainings have helped many small and low income communities to start understanding the big picture and also bring understanding to the leadership within the communities. Mr. Osler said there is a need to elevate this discussion into the executive realm of whatever organization is faced with these challenges, moving it out of the Department of Public Works and into the mayor's office, as New York City has done. Only at this level can we start to tackle the complex economic mechanisms that need to be brought to bear. Mr. Eggleston said city planners and decision makers often need information about costs and what things are worth. The tools exist now to make estimates of the infrastructure losses based on sea level rise. NOAA could include these estimates on their sea level rise mapping site.

Juliana Blackwell said the need to have consistent datums that are tied to a geodetic reference frame and keeping them connected is something she keeps trying to bring up. Everything that is going to be measured needs to be measured against something that is as stable as we can possibly define so the empirical data stands. Updating the vertical datum to a geopotential datum is important so we can really utilize GPS and GNSS to get quick, accurate heights on anything and everything. There is a need to look back at historical information, but tying sensors to GPS or GNSS and getting positions and ellipsoid heights on them will help bring the two systems together and keep things continually fresh.

Public Comment

Colleen Roche, OCS, asked Dr. Sweet to discuss some of the interagency work going on in the area of sea level rise. Dr. Sweet discussed the Federal Interagency Sea Level Rise and Coastal Flood Hazard Scenarios and Tool Task Force, which sprung from sea level work they did for military coastal installations in 2006. NOAA, NASA, USGS, FEMA, DoD are all involved and there is an opportunity through this working group to align and synchronize the types of products and science that are needed to continue the work they are doing. USACE and EPA also need this information and are looking to the agencies to work together so the sciences can maintain and provide this information.

Qassim Abdullah emphasized the importance of data standards and getting agencies to follow the same specifications would solve a lot of problems.

Taryn Sudol, Chesapeake Bay Sentinel Site Cooperative Coordinator, said they use NOAA's large-scale geospatial maps in order to extrapolate the on-site ground measurements they see, particularly how marshes and marsh migration is being impacted by sea level rise and how marsh migration itself is affecting coastal communities. The Sentinel Site turns to NOAA for science and then translates that science to coastal communities in ways they can understand and use.

William Nye said that his understanding of the HSRP is it is to provide advice to the Under Secretary of Commerce for Oceans and Atmosphere. This was his first meeting, and he felt the presentations individually were broad or high-level; collectively they contained a large amount of information, especially if you consider all of the unspoken details. Spending three days receiving information in this fashion is not conducive to formulating meaningful advice that the top executives need, if this is the basis of such advice. The topic of the NCP was largely ignored and Mr. Nye was disappointed with the procedure.

HSRP Arctic Priorities Working Group

Captain Ed Page, HSRP Member, and Ashley Chappell, Arctic Lead, and Integrated Ocean and Coastal Mapping (IOCM) Coordinator, OCS, discussed the current situation in the Arctic to help HSRP members think about what should be included in the draft issue paper. The goal would be to get a document that could be worked on over the next few months and approved at the next meeting. Extreme weather, environmental safety, and limited infrastructure are what make the Arctic truly unique. It is a new maritime frontier opening up to trade, but this brings new problems such as impacts to protected species and native populations and concern over oil spills. CAPT Page described the kinds of maritime activity happening now off the coast of Alaska. Last year, 400 vessels transited through the Bering Strait, including recreational traffic. The area does not have huge container ships and it is not really a viable or reliable trade route yet. There are large cargo vessels going to the Red Dog Mine, as well as icebreakers, research vessels, tugs, and landing craft. Ships have a lot more planning they need to do to make an Arctic voyage work and they have to be the appropriate class. Information sharing between NOAA and USCG is essential. USCG took on the Arctic Next Generation Navigational Safety Information System to deliver weather information over AIS and other means. NOAA wants access to those stations and is making good progress on that. Satellite communications are another way of providing information to mariners in the Arctic. AIS is one of the tools that could be used and is up and running. The Marine Exchange is providing natives an app so they can see when vessels are going to be passing through so they can avoid interactions with whaling parties. They looked at 2500 transits and 1500 were not compliant with risk mitigating measures, so some form of enforcement is needed. CAPT Page requested HSRP member input on the early draft which had been disseminated to Panel members. Information to mariners is the key issue. The area needs more oversight because of the high risk, low tolerance nature of the Arctic. Wanted to convey the amount and type of vessel traffic and what the issues are. New tools and technologies are needed to manage risk to an acceptable level. Safety and environmental issues are dynamic, so mariners need a way of getting dynamic information.

Draft recommendations to NOAA included evaluating where PORTS could be installed, partner with USCG for using AIS transmitters, developing a dynamic electronic Coast Pilot, prioritizing hydrographic surveys, and utilizing both NOAA and commercial resources to chart more areas based on where vessels are going. He sought comments on the substance of the draft before the next in-person HSRP meeting.

HSRP Q&A

RDML Smith asked if it was reasonable, in trying to fulfill the recommendation for more dynamic services, that the internet be considered as a way of delivering these services to the ships in the Arctic. CAPT Page said yes, they do use email and can send a lot of information. Satellite comms are getting better all the time and broadband capabilities are increasing, especially for larger ships.

Deanne Hargrave said that one thing that is unique on the Beaufort North Slope is that the water depths can vary up to a meter based on the direction the wind is blowing. There is currently no way to communicate that. CAPT Page said this is where a PORTS-like system would be helpful.

Ms. Hargrave also said that where there is ice there is no fog, and where there is fog there is no ice, so mariners are always driven in to the fog. The potential conflict for collision due to fog because ice restricts where you can maneuver is quite common.

RDML Smith said one of the things that is striking about the AIS traffic maps for the Arctic is that a lot of vessels call at Nome. Every single passenger vessel and cruise ship going through Bering Strait goes there. He asked if the Panel or any ship operators present had any opinion on the proposals for expanding the Port of Nome to be a more capable forward operating base for Arctic operations. Chair Saade said that Nome is going to be critical for being able to support the needs of the Arctic and the DoD operations there. Co-Chair Thomas said that USACE installed a wave buoy at Nome in order to assess turning it into a deep water port. Ms. Chappell said an update on this feasibility study at an upcoming meeting would be an option. CAPT Page is wholly supportive of expanding the port there and thought this would be a good item to recommend.

Chair Saade recommended including in the paper that the Canadians and Russians are doing everything they can to expand their footprint in the Arctic while the U.S. does little.

Hot Topics and Updates

Helen Brohl, Executive Director, U.S. Committee on the Marine Transportation System, provided a broad overview of the CMTS' activities. The Maritime Transportation System includes over 30 federal agencies and offices each playing a variety of roles. The CMTS serves as an interagency coordinating committee whose primary functions are to assess MTS adequacy and to promote MTS integration with other modes of transportation and marine environment uses. They also coordinate and make recommendations related to MTS-relevant federal policy. CMTS is chaired by the Secretary of Transportation; the chair of the Coordinating Board rotates yearly between four agencies and, starting August 1, RDML Gallaudet will likely be the next chair. CMTS' National Strategy highlights five priority areas for the committee: system performance, safety, security, energy innovation, and infrastructure investment. The CMTS Future of Navigation Integrated Action Team (IAT) facilitates the coordinated and integrated collection, processing, and dissemination of navigation data to enhance the safety, reliability, and efficiency of waterways and ports. This is co-led by NOAA, USACE, and USCG. Waterways harmonization is a key focus area for this team right now. The Maritime Data IAT serves as CMTS' body of experts on discovery, access, and sharing capacity of data related to the operation and governance of the MTS. A major focus for this group is enhancing access to and sharing AIS data. A publicly available CMTS paper is expected to be released on this topic at the end of March. CMTS has issued several documents on Arctic marine shipping, including a ten-year prioritization of infrastructure needs in the U.S. Arctic from 2016. They are currently updating the 2015 report on a ten-year projection of vessel activity in the U.S Arctic that should be released this summer. Ms. Brohl also briefly discussed CMTS' activities related to MTS resilience, security, infrastructure investments, and the Military to Mariner Initiative.

Captain Richard Brennan, Chief, Hydrographic Survey Division, Office of Coast Survey, provided an update on the NOAA fleet recapitalization. An interagency agreement between NOAA and the Navy was established in March 2017 to execute preliminary design for the NOAA AGOR Variant (NAV). The RFP for preliminary design was posted April 2018. There was an option to convert some vessels that had been repossessed by the Department of Transportation, but NOAA was outbid by the Navy. Another batch that became available NOAA decided not to bid on because they were not new vessels. NOAA has selected three shipyards for Phase 1 preliminary/contract design and will down-select to one vendor by the end of FY2020. Currently, they are working on the initial stages of Department of Commerce acquisition documentation for the next set that they anticipate will replace the *Rainier* and *Fairweather* vessels.

HSRP Q&A

CAPT Armstrong asked, if all goes to plan, what the timing for replacing the *Rainier* and *Fairweather* would be. CAPT Brennan said the federal acquisition process would take about ten years, but they have requested and are pursuing options that would fast track this project. These options include buying an existing design off the shelf or using the current FSV hull design.

Dr. Mayer sought clarification that the NAV is separate from the *Rainier* and *Fairweather* replacement. CAPT Brennan said yes, the NAV contract is for two ships, neither of which would replace the *Rainier* or *Fairweather.* OMAO does envision having multibeam on these vessels.

Helen Brohl asked if there are any vessels in the federal inventory that NOAA would like to have. CAPT Brennan said they looked at the NAVO ships, but they are already 25-30 years old. Others are too large for NOAA's purposes. Right now, there are not any that would make sense for NOAA's hydrographic work.

HSRP Planning and Engagement Working Group Follow Up and Discussion

Julie Thomas led the follow up discussion on the priorities matrix and items to be incorporated into the letter to the Administrator. Anuj Chopra requested that navigation be included in the fog priority. Member Thompson asked that the geodetic observations item include the need for common datums and standard formats. Ed Kelly recommended changing "fog" to "reduced visibility" to account for snow and other conditions. Anuj Chopra said that IMO's terminology is "restricted visibility."

Items suggested to be included in the letter to the Administrator included:

- Acknowledging the partnership and coordination between NOAA, USACE, and USGS and the advances made over the last year
- HSRP's work on papers for emergency response, sea level rise, and Arctic issues
- Acknowledge stakeholders positive feedback PORTS and the continuing need for expansion
- Operations and maintenance costs of PORTS is a concern to the navigation industry
- The need to address a backup for GPS
- The need for NOAA products that would address the issue of navigating in restricted visibility
- Acknowledge how foundational the reference systems are and advocate for their continued modernization
- Acknowledgement of the good work of the three offices

Co-Chair Thomas will prepare a first draft of the letter and send it out to the rest of the Panel for edits.

HSRP Member Discussion, Recommendations, and Recap

Chair Saade reviewed the working groups' membership and called for additional members. Dave Maune was added to the Arctic Working Group; Deanne Hargrave was added to the Technology Working Group; Sean Duffy, Anuj Chopra, and Ann Kinner were added to the Planning and Engagement Working Group. Every HSRP member is welcome to participate in any of the working group webinars.

Final comments from the Panel included that, even though it did not come up at this meeting, the HSRP has done a lot of work on the NCP and NOAA did a lot with their comments, that members would like to hear more from NOS office directors on where the gaps are that the HSRP could potentially address, and that the restricted visibility issue encapsulates the future of navigation; it is a benchmark to which HSRP could contribute to a great step forward.

Dr. Larry Atkinson volunteered to co-lead the sea level rise session at the next meeting.

Next Meeting

The next HSRP meeting will be August 27-29, 2019, in New Orleans, Louisiana.

The meeting was adjourned at 3:21 p.m.

HSRP VOTING MEMBERS IN ATTENDANCE:

Capt. Anuj Chopra	Vice President – Americas, RightShip
Sean Duffy, Sr.	Executive Director, Big River Coalition
Lindsay Gee	Mapping and Science Coordinator, Ocean Exploration Trust (via webinar)
Kim Hall	Principal & Founder, Brizo Maritime Consulting, LLC
Deanne Hargrave	Senior Geomatics Operations Surveyor, Geo Options Group, Shell International Exploration and Production
Edward J. Kelly, PhD	Executive Director, Maritime Association of the Port of NY/NJ
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	Pilot, Columbia River Pilots (via webinar)
CAPT (ret. USCG) Ed Page	Executive Director, Marine Exchange of Alaska
Capt. Salvatore Rassello	Director, Nautical Operations, Carnival Cruise Lines
Edward J. Saade, Chair	President, Fugro (USA) Inc. & Regional Director Americas - Marine
Julie Thomas, Co-Chair	Senior Advisor, Southern California Coastal Observing System; Program Manager, Coastal Data Information Program, Scripps Institution of Oceanography
Gary Thompson	Chief, North Carolina Geodetic Survey

NOS LEADERSHIP

RDML Tim Gallaudet, Ph.D., (Navy, ret.)	Assistant Secretary of Commerce for Oceans and Atmosphere, and Acting Undersecretary of Commerce for Oceans and Atmosphere, NOAA
Nicole LeBoeuf, Ph.D.	Deputy Assistant Administrator, National Ocean Service, NOAA
RDML Shepard M. Smith	Director, Office of Coast Survey, NOAA
Juliana Blackwell	Director, National Geodetic Survey, NOAA
Richard Edwing	Director, Center for Operational Oceanography Products & Services, NOAA
Larry Mayer, Ph.D.	Co-Director, Center for Coastal and Ocean Mapping, Joint Hydrographic Center, University of New Hampshire
CAPT (NOAA Corps, ret.) Andy Armstrong	Co-Director, Center for Coastal and Ocean Mapping, Joint Hydrographic Center, University of New Hampshire

NOS STAFF PRESENT:

Lynne Mersfelder-Lewis	HSRP Program Coordinator
CAPT Elizabeth Kretovic	Deputy Hydrographer, OCS
Glenn Boledovich	Policy Director and Chief of Policy, Planning and Analysis, NOS
CAPT Rick Brennan	Chief, Hydrographic Surveys Division
CAPT James Crocker	Chief, Navigation Services Division
Ashley Chappell	OCS
Kristen Crossett	OSC
Kevin Mackenzie	OCS
Heather Gilbert	OCS
Christine Burns	OCS

Amanda Phelps	OCS
Neeraj Saraf	OCS CSDL
Lisa Kim	NOS
Nathan Little John	NGS
Galen Scott	NGS
Virginia Dentler	CO-OPS
Melanie Coluntuno	CO-OPS

NOAA STAFF PRESENT:

Erica Towle, Ph.D.	Program Coordinator Officer

SPEAKERS:

Thomas P. Smith P.E., SES	Chief, Operations and Regulatory Division, LRD/NAD Regional Integration Team Leader, Directorate of Civil Works, U.S. Army Corps of Engineers
Rear Admiral John P. Nadeau	Assistant Commandant for Prevention Policy, U.S. Coast Guard
Sara Gonzalez-Rothi	Senior Counsel, Senate Commerce Committee
Capt. Jim Crocker	Chief, Navigation Services Division, Office of Coast Survey, NOS / NOAA
Capt. Jorge Viso,	President, American Pilots' Association
Dr. Qassim Abdullah	Chief Scientist, Geospatial Services, Woolpert, Inc.
Chris Edmonston	President, BoatU.S. Foundation for Boating Safety and Clean Water
Will Fediw	Industry and Government Affairs, Virginia Maritime Association

Susan Monteverde	Vice President for Government Relations, American Association of Port Authorities
Rear Admiral John P. Nadeau	Assistant Commandant for Prevention Policy, U.S. Coast Guard
Tony LaVoi	NOAA Geospatial Information Officer, and Chief, Integrated Information Services Division, Office for Coastal Management, NOS
Tyler Christensen	NOS Data Manager / Oceanographer, Information Management Office, NOS
Allison Allen	Chief, Marine, Tropical, and Tsunami Services Branch
Dr. William Sweet	Oceanographer, CO-OPS, NOS/NOAA
Audra Luscher	CO-OPS, NOS/NOAA
Mark Osler	Senior Advisor, Coastal Inundation and Resilience, NOS/NOAA NOAA National Weather Service
Dr. William Sweet	Oceanographer, CO-OPS, NOS/NOAA
Dr. Jack Eggleston	Hydrologist and Chief, Hydrologic Remote Sensing Branch, Water Resources Mission Area, U.S. Geological Survey
Dr. Brian K. Batten	Senior Coastal Scientist/Senior Associate, Dewberry
Rear Admiral Ann C. Phillips	USN (ret), Special Assistant to the Governor for Coastal Adaptation and Protection, State of Virginia
Helen Brohl	Executive Director, U.S. Committee on the Marine Transportation System
Capt. Richard Brennan	Chief, Hydrographic Survey Division, Office of Coast Survey

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