

Meeting Summary
Hydrographic Services Review Panel
August 27-29, 2019
New Orleans, LA

Tuesday, August 27, 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 August 27-29, 2019, at the Hotel Monteleone, 214 Royal Street, New Orleans, Louisiana. 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 9:01 a.m. He reviewed the meeting's agenda and welcomed attendees.

Rear Admiral Shepard Smith, Acting Deputy Assistant Administrator, National Ocean Service (NOS), National Oceanic and Atmospheric Administration; Director, Office of Coast Survey, and HSRP Designated Federal Official, welcomed attendees and provided information on the unique characteristics of the confluence of the Mississippi River and the Gulf of Mexico. The Mississippi River system drains 41% of the Continental U.S., flowing right past New Orleans into the Gulf. Flood control and navigation projects began after the 1927 flood reduced the country's GDP by 25% in one year. The stakes are even higher today for the management of the river. The industry and economic growth of the region have been crucial to the United States and its place in the world through its trading relationships. All of the infrastructure necessary for the seagoing and inland portions of the river comes together in the Lower Mississippi stretch. The participants in this meeting represent both aspects of this relationship. The Lower Mississippi includes some of the most important and challenging examples of HSRP topic areas, including sea level rise, subsidence, and the need for precision navigation. RDML Smith acknowledged the meeting's speakers, key attendees, and NOAA staff. HSRP members introduced themselves and briefly described their areas of expertise.

Nicole LeBoeuf, Acting Assistant Administrator, National Ocean Service, NOAA, discussed her background working in Louisiana and coastal Texas. The importance of Gulf region to the future of the U.S. economy is immense. The ports and waterways are incredibly impactful and complex, not simply because they span multiple jurisdictions, but also the complexity and diversity of the activities on the waterways and challenges of the local environment. This is why Ms. LeBoeuf has asked the HSRP to consider the application of NOS' navigational and positional programs in association with coastal adaptation and coastal planning. NOS recognizes the challenges faced by coastal communities and is committed to continuing to provide the data, products, and services. As needs change, the products need to change. NOS wants to hear from these communities about what it can do to help their livelihoods as these changes occur. She has also encouraged the Panel to provide insight on innovations in technology

that will help NOS stay current. The impacts from The National Spatial Reference System (NSRS) modernization will be profound and stretch into everyone's lives.

Congress' budget deal included top level budget figures for the upcoming fiscal years. It gave some opportunities and some direction, but has not yet provided programmatic-level spending. NOAA received FY19 supplemental funds to help deal with damages caused by Hurricanes Florence and Michael and Typhoon Yutu, as well as wildfire response in the West. Overall, NOAA received \$145.7 million in supplemental funds. NOS received \$11 million for the Marine Debris Program and \$50 million for National Ocean and Coastal Resilience Fund grants. NOS received over \$31 million for mapping, charting, and geodesy. NOAA is still working on the spend plan with Congress and hopes to have it finalized soon.

Rear Admiral Tim Gallaudet, Ph.D., USN Ret., Assistant Secretary of Commerce for Oceans and Atmosphere and Deputy NOAA Administrator, called attention to it being the week of the 14th anniversary of Hurricane Katrina and discussed its impact to him personally. America's blue economy is booming because of the data and services that NOAA provides to ensure that maritime commerce is safe and efficient and that tourism and recreation along the coasts continues to thrive. NOAA is advancing its unmanned systems (UxS) activities, with OCS being one of several offices playing a major role. In collaboration with the Department of Defense, the agency is advancing artificial intelligence for applications concerning disaster response. Modernizing the NSRS is an important step in tying together charts and navigation data. NOAA has made impressive progress on advancing precision navigation capabilities and working towards a 21st Century charting suite, including implementing the 2017 National Charting Plan. NGS' Remote Sensing Division surged after Hurricane Barry and was able to provide valuable aerial images to support disaster response. The Physical Oceanographic Real Time System (PORTS) has doubled its capabilities in the last ten years and 34 of the country's major ports are now outfitted with the equipment. Soon, PORTS will be able to disseminate data via AIS, which will advance NOAA and the Coast Guard's ability to keep mariners safe. RDML Gallaudet highlighted three of his main efforts this coming year: (1) He will be chairing the Coordinating Board for the Committee on Marine Transportation System (CMTS) and has laid out priorities for the board, including assessing the state of the MTS, advancing the data and technology behind it, and then enhancing the maritime transportation system infrastructure; (2) pursuing a "maritime moonshot," an aggressive ocean mapping, exploration, and characterization program which has gotten a lot of interest from the White House; and (3) working with the White House to host an Ocean Science Partnership Summit in November, in an effort to bring more private sector partners into advancing hydrographic services. He welcomed HSRP member's input on each of these areas.

Lieutenant Governor William H. Nungesser, Louisiana, welcomed the Panel to Louisiana. He recounted the beginning of his political career following Hurricane Katrina. Frustrated after five more hurricanes and an oil spill, he decided to run for Lieutenant Governor. As parish president, a project he proposed to the Corps of Engineers using berms to lower storm surge in Plaquemines Parish was highly successful. In order to secure funding to expand the use of berms, however, they had to show reductions in flood insurance and cost savings to the public. Unfortunately, after he left office the project stalled. In January, he will be back on the Louisiana Coastal Protection and Restoration Authority and hopes to re-implement some of those plans along all of coastal Louisiana in an effort to save the coast. He emphasized the importance of dredging not only the river but all of the navigable waterways around southern Louisiana. Maintaining these waterways should be in the budget every year, rather than dredging on an emergency basis. Pilots bring in ships every day in incredibly challenging conditions. Louisiana had a record-breaking year in 2018 with 51.3 million visitors coming to the state to sample their food, music, and culture. Lt. Governor Nungesser played a short video of Louisiana's new branding effort, "Louisiana: Feed Your Soul."

Captain Kristi M. Luttrell, Commander, Sector New Orleans, 8th U.S. Coast Guard District, welcomed the HSRP on behalf of Rear Admiral John Nadeau and discussed U.S. Coast Guard (USCG) operations in New Orleans, as well the importance of the river to the nation's economy. As Captain of the Port, Captain Luttrell has the authority to open or close the port or restrict traffic. USCG is there to keep the port and waterway safe. Her other responsibilities include search and rescue, acting as federal on-scene coordinator for pollution and Haz-Mat spills, federal maritime security coordinator for the area, and officer-in-charge of marine inspection for the port. The New Orleans District recently concluded the longest number of days above flood stage in its history, which presented many challenges and required imposing restrictions on the river. Low water can be equally challenging. Enacting the Regulated Navigation Area during hurricanes allows the Sector to protect neighborhoods on either side of the levee system. Port Coordination Team conference calls bring together many stakeholders to help determine when to close and reopen a port, and NOAA is a key member in this. They don't always have 96 hours before gale force winds reach Southwest Pass in order to make the decision to close. These decisions and others are communicated to industry via the Marine Safety Information Broadcast. USCG has a great partnership with NOAA and relies heavily on the local Weather Forecast Center and the Lower Mississippi River Forecast Center, as well as PORTS data and NOAA's Scientific Support Coordinators for pollution trajectories.

Colonel Stephen Murphy, Commander, New Orleans District, U.S. Army Corps of Engineers, presented on behalf of Major General Toy. U.S. Army Corps of Engineers (USACE) divisions are based on watersheds rather than political boundaries, which means the Mississippi Valley Division reaches from the headwaters in Minnesota to southern Louisiana. The Division's entire focus is on the river and its tributaries. Col. Murphy emphasized the importance of partnerships to USACE being able to execute its primary missions of navigation and flood risk management for the Mississippi River. He discussed Hurricane Barry and the positive collaboration of federal, local, and private partners. The region recently ended their longest flood fight after 292 days, which required over four and a half months of 24/7 operations. The area was confronted by the possibility of a "new normal" in which hurricanes come in while the river is at flood stage. It has been the wettest year in the 124 years of recorded weather history. The Bonnet Carre Spillway has been put into operation more times since 2011 than in the previous 70 years. With all of the fresh water being pushed onto New Orleans there comes tension between competing interests, but flood risk management is USACE's top priority. The Mississippi River Levee System performed extremely well, with no crevasses or overtoppings. The system is a 40-to-1 return on investment of tax dollars and NOAA is one of the partners USACE relies on for operational decision making. The navigation channels operated under restrictions for a quarter of the year and USACE's dredging operations have had more fog delays at Southwest Pass this year than in the last 30 years. After the river dropped so rapidly, there was record shoaling in the Lower Mississippi. USACE is looking at a regional contract for continuous dredging as opposed to emergency dredging. They anticipate nearly tripling their average annual dredging volume on the 30-mile stretch of the Lower Mississippi this year.

Brandy D. Christian, President and CEO of the Port of New Orleans; CEO of the New Orleans Public Belt Railroad Corporation, discussed the complexities and dynamics of operating on the Mississippi River and the importance of NOAA's weather services and tools for navigation to keep the port operating safely. The shipping industry is evolving and NOAA's work is becoming more important than ever. One of the port's biggest challenges is that ships are getting bigger and coming in larger numbers. Enhancements to precision navigation, mapping, and the increased use of air gap sensors are critical to keeping the area's ports competitive. The amount of cargo transiting Louisiana's ports is more than any other port complex in the world. Frozen poultry and resins from petrochemicals are the main exports, and natural commodities also traverse the river to and from inland markets. The Port of New Orleans grew 12.3% in containers last year, doubled volumes in the last ten years, and shows no sign of slowing down. The Port of New Orleans acquired the New Orleans Public Belt Railroad two years ago, putting them in the unique position of being the only U.S. port that can deliver six Class I freight railroads

directly to their docks. It is also the sixth busiest cruise port and the tourism industry continues to grow. Navigation safety is extremely important for these ships. Continuing to invest in the maritime facilities and dredging have a huge economic return but the port needs tools to ensure safe navigation, which have not always kept up to the pace of change in the environment and industry. Navigation restrictions lead to huge economic impacts for industries and hurt the port from a competitive standpoint. As one of the two precision navigation projects in the U.S., they are very alert to changing water levels, under-keel clearance, and air gap clearances. A combination of factors in recent years have led to considerable fog challenges that the port would not have been able to operate under without the partnerships they have with pilots, NOAA, USCG, USACE. The port advocates for more investment in navigation tools, including bank-to-bank surveys, more air gap sensors, and dredging. The State of Louisiana has committed to three years of funding \$24 million per year to attain a 50-foot draft. Every foot of available draft equates to a million dollars of economic impact per ship. Maintaining 50-foot depths is essential in keeping the Gulf area and the Midwest competitive.

Claire Trokey, Legislative Director, Congressman Steve Scalise (R-Louisiana), discussed her efforts with state and federal agencies, as well as private industry, to better understand how to keep southern Louisiana communities safe and meet the needs of the river. Maritime commerce on the Mississippi is critical to the nation's economy and trade capacity. 60% of the nation's grain and 20% of its coal transit the river. The maritime industry is responsible for 70,000 jobs and \$18 billion of economic impact in Louisiana. Congress considers these figures during their annual appropriations and biannual work on authorizing WRDA bills, and communicates with federal and state governments and private partners to understand their needs. In FY19, they authorized a ten percent increase to the Harbor Maintenance Trust Fund and increased USACE's budget by \$172 million. They are still working on FY20 appropriations. Dredging allows cargo to continue moving and keeps the nation's economy vital, as well as being important for coastal restoration efforts in Louisiana. Congress relies heavily on NOAA expertise in making federal policy and appropriation decisions

HSRP Q&A

RDML Smith said that the importance of NOAA's services to the shipping industry cannot be overstated. Cruise ships are an important part of the tourism industry and should be considered critical to the blue economy and how Americans experience the ocean. He also called out recreational boating as a major part of the area's culture and local economy. The integration of NOAA tools and information to make the most of built infrastructure is critical. He thanked the panel for their support of NOAA's programs.

Precision Navigation Overview and Implications for the Mississippi River

Sean M. Duffy, Sr., HSRP members, and Captain Elizabeth Kretovic, Deputy Hydrographer, OCS, NOA, NOAA, introduced the panel and moderated the discussion on precision navigation requirements, traffic management, and their economic impact to Louisiana and the Mississippi River.

John G.W. Kelley, PhD, Physical Scientist, Coastal Marine Modeling Branch, Coast Survey Development Laboratory, OCS, NOA, NOAA, discussed NOAA's Precision Navigation Dissemination System, which is a critical part of their efforts to support safe and efficient navigation and vessel operation in close proximity to the seafloor, bridges, narrow channels, or other marine hazards. Most mariners rely on NOAA's nautical charts, but increasingly additional information is needed to operate in confined spaces, such as real-time observations of oceanographic and weather information. NOAA seeks to make the information easily available to mariners via portable pilot units and electronic chart systems. To achieve this, NOAA's Coast Survey Development Laboratory (CSDL) is developing and implementing an IHO S-100 framework to allow for the integration of NOAA datasets and developing and testing a prototype dissemination system to provide a single location for accessing NOAA datasets. The two initial datasets they are focused on providing through this system are S-111 water surface

currents from NOS' Oceanographic Forecast System and S-102 gridded bathymetry. The datasets will be provided through a commercial cloud environment and a metadata exchange catalog will alert users when data has been updated. Marinenavigation.noaa.gov will provide one site for commercial and recreational mariners to discover, find, and learn about the extensive amount of NOAA marine navigation information available to them. CSDL is driving towards having a consistent format using S-100 standards that users can overlay different types of datasets that will be easier for manufacturers to be able to access and display.

Captain Stephen Hathorn, President, New Orleans Baton Rouge Steamship Pilots Association (NOBRA), discussed the importance of air gap sensors and velocity meters for pilots operating on the Mississippi River. NOBRA's route is approximately 145 miles from New Orleans to Baton Rouge and they service three main ports that handle a combined 374,156,267 tons of cargo. In 2018, NOBRA dispatched over 16,000 pilot turns. Their route includes 14 deep water crossings that average 2-3 miles long and only 500 feet wide. Meeting traffic in these areas means very little room for error. The route includes six bridges with the lowest, usually the Huey P. Long Bridge, only 153 feet above the water with a 17 foot range from extreme low river to extreme high river. Two other bridges will sometimes become closer to the water than the Long Bridge during high river stages, making it essential that all of the necessary data is available and accurate. Technological advancements in the last ten years have brought significant changes, as has the increasing size of the ships. The ships have gotten much larger and have more draft but the bridges haven't gotten any taller and the river hasn't gotten any wider. Pilots would like to see sensors on all of the bridges. The cost is not that high and it would give mariners the information they need to guide vessels safely. CAPT Hathorn described the costs and impacts of a recent bridge allision by a tanker that hit the Sunshine Bridge in St. James Parish. He noted that the two velocity meters that measure current in New Orleans and Baton Rouge are nearly useless because they were placed near the bank where they do not get a true reading of the current.

Captain Michael Bopp, President, Crescent River Pilots Association, discussed pilotage in southern Louisiana. Area pilots have facilitated and managed the increasing business in the ports, operating in dense fog without being able to see a thing. No other port in America is doing this. The Mississippi River is globally important but, even in New Orleans, people are unaware of its significance. Pilots want to get the most draft possible in deep draft channels. Accurately measuring under-keel clearance for the dynamic Mississippi River bottom is a very complicated task. In the delta, there could be a loss of three meters under keel overnight. Updated daily surveys are an imperative piece of data a navigator must utilize in order to maximize the deepest draft. Testing the use of multibeam surveys during the last high river period demonstrated that it is a superior method to the single beam surveys done by USACE. Guaranteeing a minimum under-keel clearance is impossible in some conditions and this must be understood by the ship's owners and managers. Pilots and ship masters must mitigate the risk of proceeding in these conditions by utilizing every available tool to safely navigate the ship. Knowing on a daily basis exactly where lumps are building is one of the necessary datapoints for maximizing available draft. Today's ships are often built for fuel efficiency rather than for enduring treacherous river conditions. Automated controls that reduce power when enough pressure is detected can become a hindrance to safe navigation. Pilots' extensive experience conditions them to assess the threat to each ship differently, allowing them to apply different levels of standards of care to different vessels. Multibeam surveys overlaid on a PPU is an invaluable tool for providing navigators up-to-date depth data and having this available will facilitate navigating with precision. Many stakeholders depend on pilots achieving their mission and pilots do everything within their power to maintain their safety record. NOAA's tools are invaluable to success.

Captain Michael Miller, President, Associated Branch (Bar) Pilots, discussed how dynamic the port system, river, and channels are and how they relate to precision navigation. The Bar Pilots handle every foreign ship that goes in or out of the river. Bulk carriers and tankers make up the majority of the ship

types. Ships coming into the river are getting much larger and they all want as much draft as they can get. The Bar Pilots service the end of Southwest Pass as it exits into the Gulf of Mexico, requiring transit between river conditions and sea conditions. To-date, over \$244 million has been spent in FY19 for dredging, while authorized funding is only \$85-95 million a year, meaning they have to constantly fight for emergency dredging. 67 million cubic yards have been dredged this year, 42 million of which was from Venice, Louisiana, to the Gulf. Much of this material is beneficially used to rebuild the coast or at least stabilize the banks at Southwest Pass so they can deepen to 50 feet while keeping shoaling to a minimum. The Mississippi River Ship Channel has had 7,500 deep draft vessel arrivals this year. Funding for continued technological enhancements should come from either the Harbor Maintenance Trust Fund or the federal government in order to accommodate bigger ships and more cargo.

Darren Wright, National Marine Program Leader, Marine, Tropical and Tsunami Services Branch, National Weather Service (NWS), NOAA, announced the new PORTS Program Manager, Chris DeVeglio, and encouraged stakeholders to get to know him. Mr. Wright presented information the Marine Weather Program in NWS. Of the 122 Weather Forecast Offices, 53 are Marine and are responsible for the coastal zones and offshore areas, including the open ocean. NWS and NOS partnered on the Tampa Bay Marine Channel Forecast project to deliver to pilots all of the available NOAA information in a single location. The Tampa Office developed a product that provides the probability of a mariner's visibility being less than one nautical mile. The pilots have responded favorably and it will be expanded across the nation through the National Blended Model. The Nearshore Wave Prediction System provides wave condition forecasts 144 hours out for anywhere along the coast and along transects. In September, Marine Weather will be updating their text products to a "What, Where, When" format to be more concise and they will consolidate all of their small craft advisories into a single advisory in December. The website, weather.gov/marine, is full of useful information and is in the process of being updated.

Craig Winn, Portfolio Manager for HD Mapping, Marine Chart Division, OCS, NOS, NOAA, presented on the Marine Chart Division's new HD Chart efforts. Many drivers are pushing Marine Chart Division in this direction, including the increasing use of deeper draft vessels. Internally, drivers include the realization of more advanced ENC production systems, increased availability of higher-quality data, and increased consumer desire for data-rich products. HD may refer to high-definition or high-density, but either way it will mean more bathymetry data in ENCs. NOAA HD ENCs will be built to IHO S-57 standards and validated against S-58. The scale will be 1 to 5,000 and adhere to the Division's chart re-scheming, a topic that would be worthwhile at a future HSRP meeting. This will be an official NOAA chart product. Initial test areas are New York, Mississippi River, and LA-Long Beach, though the Mississippi River ENCs won't be built until the hydrographic surveys are finalized; LA-Long Beach data has already been vetted so it will likely be the first to come online. Marine Chart Division is bringing more automation into the charting process so they can spin these up faster to meet consumer need. This effort is in its initial phase and Marine Chart Division is still learning about these products, as none are currently available from other hydrographic offices. He welcomed any feedback on how best to proceed.

HSRP Q&A

Sean Duffy asked about the visibility sensor in Mobile, Alabama, and what the difference is between it and the Tampa Bay model. Mr. Wright said the visibility sensor in Mobile is a part of PORTS and is an observation rather than a fog forecast. Mobile currently has two and is looking to acquire a third.

Sean Duffy also asked the panelists to comment on the need for high-resolution, large-scale maps of shoreside infrastructure. CAPT Hathorn said it could be quite valuable when they start looking at deepening to 50 feet of draft and the docks are going to have to do dredging to derive the benefit. CAPT Bopp said the probability of visibility product is one of the best tools he has seen in a long time and it is

incorporated into the PPU they use. He said that maps can sometimes be too dense for navigators, but if it can be cleared up high-resolution, large-scale maps would be valuable.

RDML Smith asked what technologies and changes in protocols were used to bring in cruise ships in low visibility conditions. CAPT Bopp said they have worked with cruise ship operators to engage a two-pilot system and improved upon that protocol, which has been very successful.

Ed Kelly asked who the private partner is for funding the PORTS program in the Lower Mississippi. CAPT Miller said that initially the Port of New Orleans paid for an air gap sensor, but now the foreign-flagged vessels are paying for it through a tariff surcharge, which he does not feel is right since they are already paying a harbor maintenance tax. Dr. Kelly asked to what degree there is collaboration with other stakeholders, particularly USACE, in handling the increasingly larger ships and if pilots are running into no meet/no pass scenarios in the channels? CAPT Miller said the port hasn't made anything mandatory yet; the pilots regulate that themselves. Due to the displacement from bigger vessels, they have seen more ships touching the bottom. The port does a lot of modeling to prepare for this. There has also been a spike in engine failure due to the introduction of different fuels and there is no room for error in these constricted areas. Dr. Kelly said he would be very interested in the high-definition nearshore mapping for shoreside infrastructure, because in some of the facilities around New York and New Jersey you cannot see water as you're entering from the boat due to the width of the ship and the narrowness of the waterway. Really accurate high-resolution mapping of the berths and land fixtures would be helpful to replace reliance on buoys and other aids that pilots might not be able to see. Mr. Duffy commented on the relationship with USACE. His board has a great relationship with USACE, NOAA, Customs and Border Patrol, and other federal partners. Many of the problems they have come back to the funding, such as with PORTS. A new air gap sensor has been approved at what appears to be a very minimal cost for operations and maintenance, but they have been unable to find a funding partner thus far. Following Katrina, there was a funding agreement between the Port of New Orleans and other partners that began to fall apart because there were so many users that benefit from the system that were not paying anything. CAPT Miller said they work with all the federal partners on the issues around ships getting bigger; billions of dollars have been spent on the Mississippi River by private industry, the government now needs to do their share. The river can't get any wider, so they have to make the most efficient use of it that they can.

CAPT Rassello said high-resolution mapping of the pier-side is helping but sensors are still needed to know the distance from the infrastructure and how fast your vessel is approaching.

Partnerships for the Future: The Mission of the Navigation Services – Data, Products and Services

Sean M. Duffy, Sr., HSRP member, and Tim Osborn, Navigation Manager, OCS, NOS, NOAA, introduced the Panel and moderated the discussion on the use of hydrographic and navigation services data, and products, and the economic impact to Louisiana, the Mississippi River, and the region. Speakers addressed gaps and offered suggestions for how NOAA can direct its finite resources to enhance safe, efficient, and environmentally sound maritime operations.

Dr. Jackie S. Pettway, Chief, Navigation Division, Coastal and Hydraulics Laboratory, U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers, discussed how various types of hydrographic and navigation data is applied in new ways to develop boundary conditions and parameters for numerical models, improve efficiency of dredging operations, and facilitate the transportation of goods on the nation's waterways. Hydrographic surveys, water levels, river forecasts, waves and climate data, and observed weather are just some of the NOAA information that are put to use in ERDC's tools. Dr. Pettway described how NOAA data works into some of their decision support tools, such as the Coastal Hazard System, and how it is used to inform dredging and minimizing maritime incidents. USACE's Lock Operations Management Application system transmits NOAA water level observations via AIS to industry. NOAA information on environmental windows assists USACE

with determining the most efficient and cost-effective scheduling strategies for dredging. The Mississippi Valley Division has been utilizing bathymetric data to monitor bedform changes and thereby improving the quality of their numerical models predicting the volumes and velocities of debris and sediment movement throughout the system. USACE and NOAA collaborate through the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) on data collection, processing, and final product formats, among many other projects. Data needs and possible future collaborations between ERDC and NOAA include: detailed measurement of overland hydraulics for validation of models, improved understanding of ocean/atmosphere/ice phenomena, gathering data required for watershed-scale modeling efforts, gathering data required for coastal resilience modeling, quantifying uncertainty in data measurements, and remote sensing algorithm development, among others.

Matt Lagarde, Assistant Vice President, Health, Safety, Security, and Environment, Ingram Barge Company, discussed Ingram Barge's operation of a wide variety of vessels on many different waterway systems. Changes in navigation equipment technology and constantly changing river conditions create unique training and product application challenges and benefits throughout the inland towing industry. Ingram operates in close proximity to the shore, shoals, structures, and other vessels. Channel conditions change rapidly and frequently with rising river levels and shifting sand bars. Pilots must learn to read the river taking note of local knowledge, river current "tells," and local landmarks. The tools barge operators use in the wheelhouse include GPS/Swing Meters, AIS, electronic navigation systems, traditional paper charts, USCG Local Notice to Mariners, river gages and forecasts, weather forecasts, lock information, and Hurricane Center information. Eventually, they would like to see all of this integrated in to the electronic charts. There are many benefits of electronic charts, but some of the drawbacks include losing the ability to write detailed notes, the content is dictated by the agency, and many of the location names on charts are not what local mariners use. Barge operators would like to see the integration of weather, river forecast information, and lock information into a single data source, as well as real-time bridge clearance data, real-time lock queue and dam output data, and 3D bottom contouring incorporated in charts. A longer-term wish list would include the ability of the system to show river current features including outdrafts, cross currents, and eddies. A display system that incorporates all of this data and predicts the track of the vessel, similar to video game golf, may be helpful.

Paul Aucoin, Executive Director, Port of South Louisiana, discussed challenges related to growth in the largest tonnage port in the western hemisphere and their efforts to address channel maintenance and maintain the flow of commerce. In addition to being the largest grain exporter and second largest energy transfer port in the U.S., the Port of South Louisiana is the top Foreign-Trade Zone in the country. Foreign investments in the area are taking advantage of the cheap natural gas and foreign-owned facilities are increasing each year. All this activity amounts to \$83 billion in trade annually and supports 30,000 jobs, plus brings in \$72.5 million in state and local taxes. More than 30 states rely on the Mississippi River for export. The Mississippi River Basin produces 92% of the nation's agricultural exports and 78% of the world's exports of feed grains and soybean. Agriculture exports support 1.1 million American jobs and every additional \$1 billion in exports creates 8,000 new jobs. Each foot of draft equates to \$1 million of economic impact. Less draft means less feet of cargo per vessel and lost revenue. Once shippers lose confidence in their ability to get maximum draft for their ships, it is very hard to get their business back. The Port of South Louisiana's goal is to provide a 50-foot draft from the Gulf of Mexico upriver to mile 256. The dredge material will be used to create an estimated 1,462 acres of new marsh habitat. USACE has called this a project of national and international significance that would provide transportation cost savings, increased navigational safety, and increased flood protection of business, farms, and homes. Mr. Aucoin discussed some of the legislative activities concerning the Lower Mississippi, including bills to authorize continuous dredging and issues with utilizing the Harbor Maintenance Tax, which has \$9 billion for dredging that is not being put to use. If enacted, House Resolution 2440: The Full Utilization of the Harbor Maintenance Trust Fund Act would require that money to be used in full.

Mike Steenhoek, Executive Director, Soy Transportation Coalition, discussed the challenges and opportunities for the nation's multi-modal transportation system – including the Lower Mississippi River – to connect U.S. farmers with international customers. What happens in the Lower Mississippi impacts what happens across the U.S.' supply chain. Producing soybeans in Brazil is cheaper than in the U.S. but due to the lower costs of shipping in the U.S., the total cost to international customers is less. America's efficient transportation system is what makes the U.S. competitive internationally and the inland waterway system is integral to that system. One 15 barge tow can transport up to 855,000 bushels of soybeans, which is equivalent to 219 rail hopper cars or 940 semi trucks. Other countries have to rely disproportionately on trucks to move agriculture. America's inland river system is the key to our past, present, and future viability and allows farmers in the Midwest to be international entrepreneurs. The Lower Mississippi River is the number one export region for soybean and corn and deepening the river is something farm coalitions are working diligently on. Illinois soybean farmers would receive \$77 million more for the value of their soybeans post-dredging of the Lower Mississippi River; U.S. soybean farmers total would realize \$461 million more. The United Soybean Board has allocated \$2 million to help underwrite the project. In a time of great uncertainty in the industry there is the potential for farmers to be more timid, but they are leaning forward and investing in their industry. Mr. Steenhoek concluded by saying that government does an excellent job collecting information, but not always in disseminating it. He challenged NOAA to meet customers where they are, taking care to do a good job with the what, the when, and the how of the information they wish to communicate.

Mark Wingate, PE, Deputy District Engineer for Programs and Project Management, Executive Office, New Orleans District, U.S. Army Corps of Engineers, discussed the role and efforts of USACE in supporting the nation's largest port complex on the Lower Mississippi River while reducing risk to Louisianans and infrastructure from severe floods. The New Orleans District includes 2,800 miles of navigable waterways and 973 miles of Mississippi River and Tributaries levees. Mr. Wingate discussed in detail how USACE and NOAA work together to maintain navigation on the Mississippi River. USACE New Orleans District operates in a very dynamic environment to maintain safe navigation and they relay channel conditions to users through collaborations with NOAA Weather Service and navigation services. The District uses NOAA's Marine Forecasts on a daily basis when planning surveys and river stage prediction tools to help perform channel maintenance requirements. NWS provides weather briefings to them before during and after tropical events so they can prepare and restore navigation. Following Hurricane Barry, NOAA used their surveying assets in Bayou Lafourche to help better understand the channel conditions and reopen Port Fourchon. USACE works closely with NOAA by providing information to augment or complement the S-57 charts which are in turn used for navigation. NOAA's tidal stations in waterways augment USACE's tidal stations and serve as back-ups if theirs have gone down. Every ten years, NOAA surveys the river and puts that information into hydrographic survey books; USACE does the same on a ten-year cycle. The two agencies need to ensure they are collaborating to acquire that information every five years. It is critical that USACE understands the forecasts of what is coming down the river. Based on this information, they determine daily how many gates to open at the Old River Control Complex to divert water down the Atchafalaya River. They then send these decisions back to NOAA so they can provide forecasts to the area south of the complex. In this they work closely, sharing models, data, and lessons learned. Opportunities for enhancing the USACE-NOAA relationship and ensuring coordination on current endeavors include: eHydro Database information provided to NOAA to add USACE soundings and channel conditions to navigation charts, augmenting S-57 charts with very similar information out of eHydro and providing it weekly to industry through the Southwest Pass Inland ENC Overlay Program and coordinating comprehensive Mississippi River hydrographic surveys.

HSRP Q&A

Tim Osborn asked how much concern the big shipping lines have in terms of high river or restricted draft and the effect on the timely arrival and departure of their ships. Mr. Aucoin said he hears about this all the time. Delays are very costly to shipping companies.

RDML Gallaudet said this a critical time for the country's economy and stated his belief that the U.S. is taking advantage of it. NOAA is doing so via transformational technologies, such as AI and UxS. The agency is also advancing its data dissemination efforts by negotiating with commercial cloud providers who will make NOAA data more widely available and allow NOAA to leverage their software capability. Improving competitiveness for the U.S. maritime transportation system is the theme of RDML Gallaudet's chairmanship of the CMTS Coordinating Board.

Dave Maune asked about the inference that the Missouri River is not as significant for agriculture transportation as the Mississippi, despite leading to prime soybean country. Mr. Steenhoek said the river is highly underutilized for transporting all commodities. It has had challenges with low water events and has a poor reputation for reliability that is worse than its actual potential. Data shows that the Missouri has consistently had suitable navigation conditions for at least the last decade and there has been some increase in shipments. The Port of Kansas City handled roughly 9,000 tons of freight in 2015; in 2018 it was 450,000 tons. Some modest investments and enhancements in the river would significantly impact its usefulness. Unfortunately, Congress isn't interested in investing in it until they see a substantial amount of traffic, but potential users say they won't use it more fully until they see some investments made.

RDML Smith said that NOAA and USACE have a handshake agreement on hydrographic coordination where each agency will perform a similar scope of work every ten years, five years out of phase. They can look into more formally memorializing the agreement if that seems necessary.

Chair Saade asked if NOAA's Marine Chart Division has seen any significant improvements to turnaround time for the hydrographic survey data coming off the vessel. Mr. Duffy said there has been good cooperation between USACE, NOAA, and the contractors, but they have had a lot of challenges with datums on the river. He always asks, when these problems are being addressed, that someone from navigation is engaged so that their perspectives and practical concerns are taken into consideration. There is a lot of differing information being distributed on the bridge heights in the area. Being able to get this information and incorporate it into decision making is a big deal for navigation. CAPT Rick Brennan said this is the first time in 50 years NOAA has surveyed the Mississippi River. The feature count on the river has been huge and getting accurate heights on those features during high water flow has been incredibly challenging and confounding their ability to deliver products. He added that USACE and NOAA should collaborate as they update river datums. The Corps will be embarking on an effort to redefine their datum soon and there is a tentative agreement that one be the boundary condition for the other so they coincide where they meet. Marine Chart Division expects to start seeing surveys rolling out in the coming 2-3 months. Mr. Osborn added that they have received a complete listing of exposed pipelines which will have significant impact on efforts to deepen the channel. RDML Smith clarified the distinction between the full coverage survey that NOAA commissioned from Baton Rouge to the Head of Passes, which includes all shoreside structures. This is a much broader scope of work than a multibeam survey of a section of a channel that would be done for a condition survey. There has been progress in turning around limited scope multibeam channel surveys within the required one day. The sensors and processing equipment have undergone major improvements in the last five years.

Public Comment

Ben Schott, Meteorologist-in-Charge, New Orleans/Baton Rouge Office, NWS, discussed the collaboration efforts during the period when the area was coming off of the extended flood stage and hurricane season was fast approaching. The office ran models so they would understand the effects of a tropical storm with the river at such a high level and what the potential impacts of surge and rainfall could

have been. Fortunately, the combined effects of high water and Hurricane Barry did not end up being at the level forecasted.

CAPT Michael Bopp said the Crescent Pilots recently decided that multibeam is a possibility going forward. They proved that they could manage a one-day turnaround for the month of July. In this time they found anomalies against the single beam surveys USACE was doing. These included lumps that were building and they were hitting with ships that were not showing up in single beam surveys. In the future, he would really like to see this technology available to the navigator.

Ryan Scully, Crescent Pilots and MRTIS.com, expanded on CAPT Bopp's comments. When it comes to setting depth, the pilots are going to come up with a recommended depth that the ships will have to adhere to, but the pilots are going to set that depth using a margin of error when they look at the surveys. Even if the channels are dredged to 50 feet, pilots will have to subtract several feet to account for the error in single beam surveys. Dredging and more accurate surveys together are the key to improving navigability.

Jon Dasler, David Evans & Associates, said that USACE Portland District has switched from using single beam surveys on the Columbia River to multibeam and the information is going into eHydro. Automated processing has led to much faster turnaround times. But it is important to note that all multibeam surveys are not equal. Object detection surveys are much more intensive than those looking at sediment transfer. In an environment like the Mississippi River, object detection surveys quickly become out of date due to sediment transport, so there needs to be a joint effort between NOAA and USACE.

Guy Noll, Esri, commented via webinar that MARAD leadership is very interested in increasing support for bulk shipping ports, particularly on the river ports, and increasing overall resiliency of the shipping system. He asked what is being done to deconflict port and river navigation information to create a single authoritative source, particularly for smaller ports as a way to improve overall reliability. Mr. Noll was no longer on the line when the question was read so the Panel did not engage in discussion on the topic.

Challenges, Concerns, and Risks for the Navigation Services Portfolio

National Ocean Service Office Directors addressed navigation services topics such as the 2022 updates to the NSRS, datums, UxS, mapping, surveying, charting, remote sensing, photogrammetry, positioning, and water levels in support of "seamless data."

Captain Elizabeth Kretovic, Acting Director, OCS, provided a broad overview of OCS' Strategic Plan. As the volume, value, and size of marine vessels in U.S. waters continues to grow, it is essential that OCS resolves critical data gaps and increase the accuracy and frequency of their surveys. It is a pivotal time in ocean mapping, and while OCS continues their work to deliver real-time data and high-resolution bathymetry for ports and maintain nautical charts for the U.S. marine highway infrastructure, they are also working toward building a comprehensive and high-resolution bathymetric dataset of the unseen America. The continued strength of OCS's valued partners, its highly skilled and dedicated workforce, and its ability to fully leverage technology is key to achieving this substantial modernization effort. OCS leads a coalition of U.S. federal offices that provide hydrographic and meteorological services working in close coordination to achieve shared mapping objectives. The goals of the OCS Strategic Plan are: (1) To deliver world class digital navigation services to the maritime community by building a second-generation ENC suite, producing new precision navigation products, and expanding the access and usability of navigation services and data; (2) To map the unseen America by leading a national coalition to double the rate of surveying in unmapped U.S. waters, maintaining federal channels, anchorages, and fairways within high volume U.S. ports at CATZOC A1, and reducing the backlog of 10,000 chart discrepancies; and (3) To sustain high performance of people and systems for mission success by being a model federal workplace as measured by the Federal Employee Viewpoint Survey, leading the world in marine geospatial expertise, responding to changing customer needs, developing and maintaining critical

infrastructure, and integrating new and innovative technologies into their mission priorities. CAPT Kreovic discussed recent activities intended to advance these goals, including a well-attended industry workshop on precision navigation, the development of marine.vnavigation.noaa.gov, a nautical cartography open house, a chart adequacy workshop, and graduating the second class of NOAA's certification program in nautical cartography.

Richard Edwing, Director, Center for Operational Oceanographic Products and Services (CO-OPS), provided an overview and status of the PORTS program. CO-OPS operates two base funded observing systems: (1) the National Water Level Observation Network (NWLON), whose 210 stations provide water level, wind speed/direction, barometric pressure, air and water temperature, and conductivity; and (2) National Current Observations, which collects short-term current observations to update tidal current predictions. The PORTS program works with partners to provide all of the observation parameters they identify as necessary for safe and efficient navigation. CO-OPS offers this real-time information through a variety of products which have changed over the years. A few years ago, CO-OPS calculated the value of an inch of draft and found that, with one additional inch of draft, a ship could carry 99 additional Chevy Volts, worth over \$4 million in sales; 36 additional John Deere tractors worth \$2.4 million; or 163 additional metric tons of U.S. beef worth of \$500,000. Non-navigation uses of PORTS data include providing real-time storm surge data, which help protect coastal marine resources. PORTS is a partnership with responsibility shared between NOAA and the local maritime community. The most important thing CO-OPS does is system monitoring and quality control 24 hours a day, seven days a week. They are always looking for ways to improve the observing system through a test and evaluation system. There are 33 capital PORTS serving 76 seaports around the country, which combined handle over 90% of the cargo tonnage in the U.S. The program has doubled in the last ten years and they are up to 895 individual sensors deployed. The main drivers for the growth of PORTS have been increasing ship sizes, more congested waterways, decreasing margins of error, and shipping companies wanting to maximize reliability, predictability, and efficiency. Recently, establishing or expanding liquefied natural gas (LNG) and Navy capabilities have been drivers, as well. The system provides over \$50 million (in 2010 dollars) in economic benefits annually and has led to a reduction in accidents. It is estimated that a fully built out national program would provide \$300 million (in 2010 dollars) in annual value. Studies have demonstrated the impact of PORTS on vessel allision, collision, and grounding incidents and found a 43.9% reduction in the total rate of these incidents at seven locations. From 2008 to 2015, areas with PORTS saw an increase of over 191% in the vessel transits per grounding compared to a decrease of 34% in waterways without PORTS. Forecast models are a great extension of the value of real-time information

Juliana Blackwell, Director, National Geodetic Survey (NGS), provided some highlights of NGS' work, primarily focusing on the NSRS modernization effort. The NSRS includes geodetic datums, which are used not only for the foundation of mapping, charting, and geospatial data, but also play an important role in precision navigation products. Within NGS, there are two primary programmatic areas: the geodetic side and the coastal mapping side. They have learned over time that defining the national shoreline with recent technologies and the byproducts of doing that work are applicable for a number of other uses. The Remote Sensing Division's coastal mapping effort provides the component of how the water relates to land and to geodetic datums, which is essential for precision navigation. It is essential to know what datum your data was collected in and to be able to transform that data between different datums. VDatum is one of the primary tools that allows geodetic, water level, and tidal datums to work together in the geographic locations NGS is responsible for. What NGS collects meets the accuracy and scale of current precision navigation products, but requirements are going to be evolving and NGS is always looking at how to improve the information that will feed into 3D or higher definition charts for all transportation modes. Ms. Blackwell discussed NGS' use of unmanned aircraft systems, in particular activities at the NGS UAS Testing and Training Center, establishing NOS UAS risk acceptance procedures, and providing training and support for other NOAA Offices and partners. NGS has a number

of projects underway using Hurricane Supplemental Funds to acquire coastline data for areas impacted by Hurricanes Harvey, Irma, and Maria. NGS was able to fly surveys during Hurricane Barry to quickly collect data and provide aerial images for emergency managers to identify areas to provide additional resources. NSRS Modernization efforts since the previous HSRP meeting include releasing the third part of the *Blueprint for 2022* technical report, hosting a Geospatial Summit, publishing changes to policies and procedures relating to the State Plane Coordinate System, releasing the *Status Report on the Products and Services of the Upcoming Modernized NSRS* technical memorandum, updating the NGS Research Plan, and releasing VDatum 4.0. As of August, 77.5% of the airborne gravity collection had been completed for the GRAV-D (Gravity for the Redefinition of the American Vertical Datum) project. The GPS on Benchmarks campaign is ongoing and provides updated geodetic information on survey marks to improve the 2022 transformation tool. NGS is also in the process of updating the coordinates and velocities for the NOAA Continuously Operating Reference Station (CORS) Network and aligning those with the latest international terrestrial reference frame (ITRF2014). NGS has been able to hire a CORS Program Manager, has established five Foundation CORS sites for FY19, and is working on interagency agreements that will allow them to adopt stations owned by other partners and establish them as Foundation CORS. In preparing for 2022, one of the most important things people can do is to manage the data that they have now and to understand the metadata associated with the geospatial data in their projects, what reference frame it's referenced to, what epoch, what models were used, what was used for project control, knowing when it was surveyed, and retaining original GPS data to support reprocessing. Those able to do so can help support NGS's transformation tool by collecting additional data using the guidance on the GPS on Benchmarks campaign and providing feedback on their beta products. Ms. Blackwell concluded by provided a timeline for the rollout of various datum updates.

Stephen White, Remote Sensing Division, NGS, NOS, NOAA, discussed current activities of the VDatum Program, as well as challenges and future development efforts. VDatum was developed by NGS, OCS, and CO-OPS for converting elevation data among different vertical datums. Geodetic and tidal datums form the foundational data observations that feed the modeling efforts (hydrodynamic and topography of the sea surface), which includes an uncertainty estimate associated with the transformations. These feed into the software development and outreach, training, and coordination. These three components together make up VDatum, which supports three categories of vertical datums: 3D/ellipsoid (realized through space-based systems), orthometric (based on a form of global mean sea level), and tidal datums (based on tidally-derived surfaces such as high or low water). Mr. White presented the online tools available at vdatum.noaa.gov, including the recently released Version 4.0 that integrates NADCON 5.0. The VDatum transformation tool assures data is transformed correctly, enables multiple uses for datasets across applications, permits merging of disparate datasets to a common reference, and provides transformation uncertainty estimates for intelligent decision making and analysis. Strategic priorities for VDatum include creating consistency between regional models, reducing regional model uncertainty to less than 10 cm, increasing coverage, creating the next generation topography of the sea surface (TSS) model, looking at spatially varying uncertainty (SVU), continued software development, as well as communication and outreach. There are still areas around the mid-Atlantic coast where model consistency issues prevent valid transformations in VDatum. The tool continues to have high uncertainties in the Pacific Northwest, around Louisiana, and in Texas' estuaries. The New York Bight is the only area with operational SVU, though they will be developing SVU for the entire West Coast, mid-Atlantic, and Puerto Rico soon. It is very important when collecting multibeam or lidar data to understand the varying uncertainties as you move around a region. Better understanding where they have high uncertainties will allow the Remote Sensing Division to target where foundational observations are needed. Supplemental funds have been very helpful for VDatum coverage, helping expedite the work by 5-10 years. The GPS on Benchmarks campaign is a critical effort needed to tie the geodetics to the tides, an essential link for developing the TSS. Mr. White reviewed HSRP's VDatum recommendations and provided status updates on each of the items.

HSRP Q&A

Vice Chair Thomas asked when OCS' projected marinenavigation.noaa.gov would be online. CAPT Kretovic was unsure due to difficulties in hiring a developer. One should be onboard in December and they expect to see things come to fruition fairly quickly. OCS will probably to start populating the website within a year.

Vice Chair Thomas asked if CO-OPS have the resources to continue quality control and oversight of the data once the data is ingested and becomes operational. Mr. Edwing said they write the requirements at the start of the process. The test and evaluation process takes into account the technology and ensures the data pipeline is in place, part of which is being able to do quality control.

RDML Smith asked for further information on the accelerated tidal datum epoch effort for Louisiana. Mr. Edwing said it is one of the locations where they do five-year tidal datum updates due to exceptional land motion. Tim Osborn added that from 2012 to 2016, they made an adjustment of 3.3 inches for southeastern Louisiana.

Jon Dasler asked if there has been further discussion on starting to incorporate additional gage data, such as the Corps', in PORTS to help pilots, even if a disclaimer is necessary. Mr. Edwing said there have been discussions, more so with USGS than with the Corps, but it has proved to be very challenging because each District or center does things differently. CO-OPS has been working with USGS on getting them to build stations to NOAA hardware specifications, but the different centers handled the data differently and NOAA cannot afford to build new ingest mechanisms for several types of stations. It is a goal of Mr. Edwing's to get all of these stations to a similar standard where agencies can exchange interoperable data, but it is not likely to happen soon.

Jon Dasler commented on the issues in Louisiana with geoid models and datums. He said having CORS stations co-located with tide stations would be helpful, especially in areas with significant subsidence or glacial rebound. Being able to bypass the geoid model and go directly to ellipsoid heights would be beneficial. It would also be great to have a GPS on Tidal Benchmarks campaign. Ms. Blackwell said many of these things are underway and offered to speak with him offline. To increase the number of CORS stations and to have continuously operating GNSS stations associated with water level stations would require additional resources.

HSRP Planning and Engagement Working Group

Julie Thomas and Dave Maune, P&G Work Group Co-Chairs, led the discussion.

Dr. Maune proposed a new issue paper topic concerning Arctic mapping in areas supplied by barges with little or no maritime infrastructure and great needs in order to operate efficiently. This emerged from the previous HSRP meeting in Juneau, Alaska, where speakers addressed the issue of bringing fuel and other commodities ashore to small villages. Dr. Maune attended the Alaska Mapping and Surveying Conference and found they are working on coastal strategies that share a lot of common interest with the HSRP. There are enormous NWLON gaps around Alaska where people do not have access to good information, in addition to several other issues. The State of Alaska has developed a list of tidal datum priorities for over 150 villages. Dr. Maune is waiting to get more updated information from the Alaska Department of Natural Resources on how these priorities have changed, but they agreed that getting continuous topo-bathy for these villages is needed. Dr. Maune recommended choosing a couple villages to install short-term observations, tidal benchmarks collecting bathymetric data from sonar and topographic data from lidar, to see how well it works and what it costs. If it proves beneficial, he would recommend exploring what funding partnerships might be developed. The Alaska Mapping Executive Committee has been very successful in coming up with funding partnerships, and the HSRP should build

upon that success. Dr. Maune asked for the Panel’s approval in pursuing this topic as an issue paper. The Panel took a vote and it passed with two opposed. Dr. Kelly said the cost-benefit analysis may be something for NOAA to consider, but with the priorities the HSRP has he wasn’t sure if this was something the Panel should spend its limited time on. CAPT Page agreed that the cost of doing things in Alaska is very high and the return very low, but there is a need and it is worth exploring. Ms. Hall said she opposed because she thought there were issues that are bigger for the HSRP at this time. Issue papers are a lot of work and require significant time of the members. Vice Chair Thomas said that Dr. Maune had already put so much work into the draft issue paper that they will review it at the next meeting and decide what to do with it. CAPT McIntyre said that it doesn’t have to have a positive cost-benefit ratio in order to be worth considering and the HSRP’s recommendation may just be to keep these small communities in mind.

Recap and Day 1 Wrap Up

Chair Saade led the recap of the day’s session. Members felt the panels were very informative and they were impressed with how NOS leadership is integrating the suggestions coming from the HSRP, including developing the relationships with USACE and the focus on PORTS. Convening the meeting in New Orleans made clear to them the many challenges present in the waterways and all of the things that NOAA does to help them maximize efficiency. The importance of relationships in resiliency efforts was made clear, as well as full integration of resources and training for emergency response. Southern Louisiana is a good testbed for addressing issues that can then be extended elsewhere. The impact of the region on the blue economy was also made evident and getting a better sense of local challenges and opportunities is precisely why the HSRP needs to hold meetings around the country.

RDML Smith said the day’s session met his expectations of giving the Panel a sense of the Mississippi River and the uniqueness of the ports of Louisiana as a complex. He was struck by the issue of efficiency in the ports being an issue of national competitiveness. Any efficiency gains that NOAA navigation services could bring to bear would have a big impact on the local and national economy.

Anuj Chopra suggested that NOAA consider three more ports for hydrographic surveys: the Houston-Galveston Waterway, Corpus Christi, and Port Arthur. These ports are undergoing massive expansion and their exports are increasing dramatically, and therefore require more attention.

Adjournment

The Panel stood in recess at 5:32 p.m.

Wednesday, August 28, 2019

The meeting was called to order at 8:37 a.m.

Chair Saade and CAPT Kretovic welcomed attendees to the second day of the meeting and reviewed the subjects to be discussed.

HSRP Planning and Engagement Working Group Discussion

Julie Thomas and Dave Maune, P&G Work Group Co-Chairs, led a discussion of the HSRP’s feedback to OCS on their Strategic Plan.

CAPT McIntyre recommended including a cybersecurity component in the OCS Strategic Plan. CAPT Kinner and Ms. Hall agreed. Ms. Hall stated that maritime cybersecurity should not necessarily be focused on the tools and solutions, but on strategies. There are many solutions available, but nobody seems to be focusing on governance and understanding what needs to be done. A simple mention of cybersecurity in the plan should be sufficient. CAPT Kretovic said that as OCS explores working in the cloud cybersecurity is part of their considerations, but it may not be included in the official plan. The point is well taken. Ms. Hall agreed to draft a sentence to capture this in HSRP's feedback. CAPT McIntyre said the rest of their comments were editing for clarity and consistency. The HSRP unanimously approved the comments on the OCS Strategic Plan.

Vice Chair Thomas led a discussion of the HSRP's Priorities Matrix, confirming the status of each of the items. "Hardening of offshore observational sites" was removed as a priority item. Discussion of AI was tabled until the San Francisco meeting in order to take advantage of the expertise there and give members time to hone in on what aspect of AI they feel is most relevant. For the "public-private partnerships" item, Mr. Thompson said he's involved in a committee working on this topic and maybe the HSRP could get in complement the National Geospatial Advisory Committee's efforts. Kim Hall suggested listing topics that are no longer a priority in an archive column so people know what the Panel has worked on in the past, including the NOAA-USACE relationship.

Partnerships and Unmanned Systems for Hydrographic Surveying

Ed Saade, HSRP Technology Working Group, and Neeraj Saraf, OCS, introduced the panel and moderated the discussion on how NOAA and industry are moving forward with autonomous systems to provide mapping, charting, and remote sensing for both marine navigation and aerial shoreline surveying.

Rear Admiral Tim Gallaudet, PhD, U.S. Navy (Ret.), Assistant Secretary of Commerce for Oceans and Atmosphere and Deputy NOAA Administrator, provided an overview of NOAA's new UxS strategy. Unmanned and autonomous systems are going to transform how NOAA and its partners do business. They will allow for major improvements in coverage, accuracy, and how NOAA does business end-to-end. Today's R&D advancements are being made in the private sector and NOAA needs to turn in this direction for its partnerships. NOAA has about 100 of its own drones (surface, underwater, and aerial) to help in all aspect of their mission. AUVs and USVs are utilized in hydrography applications and aerial drones are being used for feature identification. NOAA has an active unmanned aircraft systems (UAS) research program and will be standing up an operational program in 2020 housed in the Office of Marine and Aviation Operations (OMAO). The CENOTE (Commercial ENgagement through Ocean TEchnology) bill has been signed by the President and directs NOAA to partner with the Navy in the Mississippi area to expand its unmanned maritime systems. NOAA's researchers have been engaged in UxS studies for a long time and the agency continues to build on this work to further enable its blue economy and weather/water priorities. NOAA will be making the UxS program more operationally focused by centralizing the functions with professionals doing certification, acquisition, training, and standards development. NOAA's UxS Strategic Plan is in the process of being finalized and consists of five goals with supporting objectives: (1) Consolidate core functions to ensure efficient organizational structure; (2) Advance research and innovation; (3) Accelerate UxS research-to-operations; (4) Strengthen and expand UxS partnerships inside and outside of NOAA; and (5) Promote a NOAA workforce that is proficient in all aspects of UxS. The plan should be released in the fall of 2019. UxS is one of three main technology focus areas for NOAA, the other two being AI and omics. These three together are rapidly advancing to transform how NOAA does business in smarter ways that will improve its skills at a reduced cost.

Michael J. Starek, PhD, Associate Professor of Geospatial Engineering, Texas A&M University Corpus Christi; Director of the Measurement Analytics Lab (MANTIS), Conrad Blucher Institute for Surveying and Science, discussed current work related to the use of small UAS for surveying and

monitoring of the coastal zone within south Texas and other Gulf regions. This work includes wetland resilience, post-storm impact assessment, near-shore processes, and survey-grade UAS lidar. Advantages of small UAS for coastal mapping include rapid deployment to target events, temporal repeatability, flexibility and automation, cost effectiveness at local scales, and hyperspectral imagery. Some of its limitations include endurance and extent of coverage, payload capacity, weather, and regulations. The Conrad Blucher Institute is using UAS to do structure from motion (SfM) surveys. In these surveys, software overlaps images and then automates how it matches features between the images and reconstructs camera position and orientation to produce a dense 3D point cloud similar to a lidar point cloud, but with different behavior. The main uses derived from this are a digital surface models tied to vertical datums, a digital elevation model that you can correct the imagery and drape on top of, and the ability to provide good GIS products at very low cost. Dr. Starek described the Regional Geospatial Modeling Project as an example of UAS's usefulness in wetland monitoring around the Mission-Aransas National Estuarine Research Reserve in order to get aerial data to fuse with terrestrial laser scanning. This technology was also used to monitor erosion in wetland sites following Hurricane Harvey. Deep learning is a methodology well-suited for RGB (red, blue, green) imagery. It was also used for mapping built environments; quantifying structural damage from Hurricane Harvey allowed structural engineers to evaluate in a very cost-effective manner why one structure performed better than another. Shallow water UAS photo-bathymetry is very challenging because the algorithms rely on feature mapping where you don't want any motion from things on the ground, but water is dynamic. Water clarity, refraction, and specular reflection are also issues, but in certain scenarios SfM is a good choice. Airborne lidar has an advantage over SfM by being much better behaved from a surveying perspective and providing multi-echo detection, which allows users to penetrate through vegetation. There is still a lot of work to do for UAS, particularly in regards to developing best practices for coastal surveying. Maintenance, safety, and training are continual and they must be adaptable to rapidly changing technology and regulations.

Neeraj Saraf, Acting Chief, Coast Survey Development Laboratory, OCS, NOAA, NOAA, provided a summary of the ongoing autonomous surface vehicle (ASV) research and development at the UNH-Joint Hydrographic Center (JHC), its relevance to NOAA's navigation services mission, and examples of research activities. Beyond testing prototypes, JHC strives to further the mission of OCS in terms of the ocean mapping and hydrography work they do. In addition to expanding onboard tools and capabilities, ASVs can also be used in areas that pose a higher risk to humans or equipment, such as closer to shore or areas with heavy ice. Mr. Saraf presented a possible outfitting for NOAA Ship *Fairweather* equipped with multiple ASV devices that would increase its coverage by three times. A collaboration between OCS, National Marine Sanctuaries, and JHC on a Navigation Response Team scenario in Thunder Bay National Marine Sanctuary explored how autonomous technologies could be used in an emergency response capacity. They tested out many new technologies, including a real-time Neural Network for Object Detection and Classification. Other collaborations discussed included working with National Geographic to find wreckage of Amelia Earhart's plane in areas too dangerous for manned vessels, trials with the iXBlue DriX ASV, and using EchoBoats in Greenland to survey ahead of ships in uncharted waters. The OCS Ocean Mapping Plan defines strategic goals for enabling maritime commerce, lays out a visionary goal to map the entire Exclusive Economic Zone (EEZ), identifies the key blue economy technologies necessary to complete this mapping in our lifetime, and focuses on UxS and automated processes. OCS has done some machine learning projects over the last few years and there will be more to come on that. Andy Armstrong added that the DriX trials are coming up in October, trialing the wingman approach by making adaptations to the NOAA Ship *Thomas Jefferson*'s davits. It is a particularly seaworthy, high-speed, and long-endurance ASV that they can operate around the clock in tandem with the *TJ*, only bringing it aboard for refueling every few days. This is an opportunity to double the *TJ*'s mapping capability with only one ASV in a straightforward and efficient manner.

Captain Brian Connon (U.S Navy, ret.), Director, University of Southern Mississippi's Hydrographic Science Research Center (HSRC), provided an overview of hydrographic research at

USM's HSRC, with a focus on unmanned projects funded by NOAA OCS. CAPT Connon stressed the importance of NOAA's academic partners in accomplishing their mission, in terms of both training the next generation of hydrographers and the research side exploring new technologies and getting us where we need to be faster. He discussed USM's hydro program, started in 1999 by Rear Admiral Ken Barbor, offering one of only two Category A programs in the U.S. and the only Category B undergraduate program. The HSRC was established in 2011 in partnership with the Navy to support their hydrographic efforts. Their previous work includes a quantified error budget for NAVO survey ships, extended range of precise positioning techniques, verification and validation of electronic charting methodologies, developing GPS tide buoy techniques and standard operating procedures, and the Coastal Zone Mapping and Imaging Lidar project that fielded the next generation of airborne sensor supporting the National Coastal Mapping Program. They are currently supporting OCS work with the L3 ASV Global C-Worker 5, developing standard operating procedures and certifications, as well as integrating sensors, Saildrone surveys in remote areas, and an unmanned aerial vehicle project. They support NOAA OER with two autonomous underwater vehicles (AUV), the ISE Explorer-class *Eagle Ray* and the SeaBED *Mola Mola*. He discussed each of these projects and the sensors used, as well as some of the lessons learned. The industry is moving towards autonomy, but it's not there yet – as the technology of the sensors onboard and the amount of data they are collecting increase, the interaction with a human operator has to be present, monitoring and reviewing the data and communications. These sensors weren't built to work on their own and working with industry on how to improve connections will be essential. CAPT Connon has been impressed with the data quality but wants to be able to see it in near-real-time so adjustments can be made as needed. Maintenance is also an issue when UxS are out for thirty days at a time. The HSRC has a partnership with USM's Polymer Institute to develop new coatings to reduce the amount of marine growth on the vessels.

Thomas S. Chance, Former CEO, C&C Technologies and ASV Global (ret.), provided an overview of various unmanned vessels, optionally manned vessels, and minimally manned vessels that can be used for hydrographic surveys, as well as the kinds of conditions and operations they are best suited for. NOAA is converting some of their manned survey launches into optionally unmanned vessels; this is a positive step forward. Minimally manned vessels have a small onboard crew whose job is just to fix equipment when it breaks, everything else is controlled remotely. This allows the payload to be more complex. Force multipliers have become increasingly useful, with some unmanned vessels doing more work than manned vessels on adjacent surveys. Adding additional unmanned boats to a survey could double or triple the survey capacity at a fraction of the cost of a big ship. To date, most of this work has been done within line of sight, using radio links to a mother ship or the shore. It is now possible to do more beyond line of sight (BLOS) work using a satellite link. For any vendor that NOAA works with, they will need to work with them continually as the process requires iteration. USV lessons learned include: for real-time survey production, a cheap USV can be very expensive, as component parts will need to be replaced; batteries don't cut it, diesel is the better choice; small (<2m) monohulls can have aeration problems; beware of heat and water; get good connectors rather than cheap ones; launch and retrieval from mothership is 50% of the equation; do not expect off the shelf USVs to work; buy one USV, have the manufacturer debug it, then buy more of same; hydrography is one of the easiest applications for USVs; don't confuse great USV graphics with years of USV experience; make sure your USV manufacturer has extensive maritime experience; COLREG autonomy has not been perfected and supervision is still necessary; and always check with the other USV users before buying.

Lt. Damian Manda, Chief, Hydrographic Systems and Technology Programs Branch, Coast Survey Development Laboratory, OCS, NOS, NOAA, provided a summary of UxS development and operational use to augment NOAA's hydrographic data collection capabilities, and OCS' UxS strategy updates. OCS' Strategic Plan includes a bullet point for integrating new and innovative technologies into mission priorities. The UxS vision for this is to develop and utilize unmanned vehicles for more efficient and effective acquisition of data to support NOAA's navigation products and services. Lt. Manda briefly

discussed use cases and different types of vessels and the applications for which they are best-suited. OCS' UxS strategy breaks down into four main focus areas: (1) develop enabling technologies, particularly enabling automation in processing; (2) build and maintain operational expertise by standing up the Navigation Response Team in Mississippi to be a Center of Expertise for UxS; (3) operational innovation, particularly focusing on optionally manned launches and collecting shoreline using UAS; and (4) collaboration, especially with the Navy, UNH, and USM. The Navy is undergoing a similar autonomous launch conversion using the same vendors and OCS hopes to leverage that directly to make improvements to NOAA systems. Nearly all of the designated UxS goals for 2019 have been met, including reducing shipboard data processing effort by 50% from the 2017 level, fully staffing and resourcing the NRT Center of Expertise, operational use of launch in unmanned configuration, UAS shoreline field use, integration and operation of seafloor mapping sonar on Saildrone, and DriX testing aboard the *Thomas Jefferson*. In 2020, CSDL is looking to have six operational optionally manned launches, continued reduction in manual data processing, testing situation and navigation improvements for USVs begin, and shoreline mapping via sUAS be more widely used.

HSRP Q&A

Chair Saade said that contractors and UxS operators see the inability of marine operators to set standards for using these technologies over the horizon as one of the biggest problems. Until BLOS operations are allowed, the full benefits of autonomous vessels will not be realized. USCG and international authorities do not seem to be making progress on this issue. RDML Gallaudet said that gliders operate over the horizon and hybrids are something that NOAA should be looking at. Mr. Chance said he has gotten conflicting answers on what is permissible. For BLOS work, operators need to be sure to have remote VHF capability, because if a USCG boat pulls up you need to be able to respond to them. CAPT Connon said vendors are doing huge underwater ocean searches using multiple AUVs, potentially using an ASV as a communications relay – this is a very expensive proposition. For a search it is okay, but for ocean mapping requirements it presents many challenges, such as being able to maintain navigation quality for long lengths of time and the increasing data risks for every hour under water. Improving the ability to retrieve data or at least processing and offloading onboard during longer missions would be a good first step.

Deanne Hargrave asked if ancillary datasets acquired from autonomous systems, such as turbidity measurements or currents near the seafloor, are being used or if HSRP's recommendations on this might be helpful. CAPT Connon said they have explored using ASV data in other applications, such as the possibility of mapping hypoxia in the Mississippi Sound. From the academic and research side, they are willing to try anything, it's just a matter of what the customer wants. The information should be going to NOAA data centers but he was not sure if that is a standard requirement for collection.

Sean Duffy said these technologies will hopefully improve options for how the Lower Mississippi River is surveyed. Utilizing multibeam surveys would make a big difference in the area and probably on many other river systems. Chair Saade said the new technologies are capable of achieving eight knots, and the faster they can go the better they would be able to withstand the challenges of the currents. CAPT Connon said battery versus diesel is a big part of this. With the multibeams available now, users can angle the sonar head and get the center line measurements without having to run a survey through the center of a channel. Being able to process data as it is being collected so there's minimal cleaning to be done once it comes in could also create an organic asset for the pilots and ports. Mr. Chance said multibeam came out 25 years ago and the processing improvements have come so far that, whether manned or unmanned, the cost of multibeam instead of single beam will be negligible. CAPT Connon added that multibeam allows users to start modeling to predict when they will need to dredge or check on sediment buildup; they may be able to cut down on their surveying needs.

RDML Gallaudet discussed two important developments relevant to the HSRP. NOAA and the White House will be hosting an Ocean Science Partnership Summit in the fall focusing on ocean technologies, including mapping. The White House has also asked NOAA to lead a major interagency effort to develop a national strategy for ocean exploration that will involve mapping, characterizing, and exploring.

Public Comment

Audra Luscher said that there is a need for applications related to coastal mapping and sea level perspectives, but the UxS strategy is focused more on the navigation portfolio. She asked if the panelists felt that NOAA needs to be looking outside of navigation and expanding into the studies around coastal risk and how these technologies are being used to meet both missions. CAPT Connon said NOAA is doing a lot of work in this area with VDatum and subsidence, but there could always be better collaboration. In fora like this meeting and others on the hydrographic side, they are seeing more coastal resilience issues coming up.

Vitad Pradith asked if there is a current strategy for shallow water areas (60 feet or shallower) for USVs and what NOAA's needs are from this perspective. Some of these platforms are too large for really shallow areas. Lt. Manda said that very shallow near-coastal areas are the realm of the NRTs and the reason for having small unmanned assets operating out of the Stennis NRT. They have vessels equipped with multibeam echosounders capable of operating in less than one meter of water. Up to the shoreline mapping and SfM presents some possibilities in some regions, as well as UAS-mounted lidar. Ship-launched smaller to mid-sized vessels can also be used right up to rockfaces and in other dangerous areas. CAPT Connon said airborne lidar is an underutilized asset for shallow water work. It depends on the situation to determine the best asset to use to tackle the problem. Dr. Starek said there has been a lot of development on the small UAS side and bathymetric lidar technology keeps miniaturizing and improving, such as with photon counting lidar to help penetrate turbid water.

Priorities Matrix Discussion continued

Julie Thomas led the discussion in continuing the review of the status for each of the topics in the matrix.

NOAA Fleet Recapitalization Update

CAPT Rick Brennan, Chief, Hydrographic Surveys Division, provided the brief update. NOAA has funding for two Class A ships that are currently in the design process; however, they are not expected to be hydrographic vessels. An independent planning team is finalizing top level requirements for Class B vessels, whose primary mission will be charting and surveying. The proposed 10-12 year timeframe for delivery of a vessel is unsatisfactory. This has been conveyed to OMAO, who is exploring options for expediting the plan. One possibility is using a modified Fisheries Survey Vessel hull design. Models of this single-prop vessel are currently undergoing testing and a new model for a twin-prop version with Z-drive propulsion that is DP3 capable is forthcoming. This could shorten the design period by up to three years. Hydrographic Surveys Division is developing Milestone 1 documentation and anticipates Department of Commerce approval by the end of FY19. Hopes for acquiring ships repossessed by the Department of Transportation have fallen through. DOT has four more in a reserve fleet that they can't do anything with so NOAA is pursuing options for how they might make use of them. Mike Aslaksen added that NOAA recently bought a KingAir 350ER, which will carry NGS equipment, and a Gulfstream 550 for reconnaissance and the GRAV-D program.

Working Group Updates

Technology Working Group

Ed Saade, Working Group Co-Chair, said the group has met infrequently since the previous HSRP meeting. Before the next meeting, the working group intends to host a Seabed 2030 update conference call for the Panel and will organize an artificial intelligence background/update to give members an idea of what to expect for the San Francisco meeting. They intend to get back into the routine of doing briefings every couple of months.

Arctic Priorities Working Group

Ed Page, Working Group Co-Chair, said the group’s position paper addressing Arctic challenges and needs is nearly complete. The Arctic is still a hot issue in Washington and the media. The most recent CMTS report expected a modest increase in traffic, perhaps 500 deep draft ships a year transiting the Bering Strait by 2030. Shipping companies have a lot of hesitation in transiting Arctic waters given the environmental issues, uncertainties, and lack of infrastructure. There will be more shipping and there is a zero-tolerance issue that will necessitate attention and warrants NOAA’s involvement. Chair Saade asked about melting and ice retreating in Russia’s Arctic. CAPT Page said they have less heavy ice than we do, but Arctic shipping is a larger part of their economy than ours so they have invested in large ice breakers. They are experiencing the same thing that all Arctic nations are: less of a challenge getting ships out, seasons extending further, and a much longer transit season. There won’t be big growth in shipping activity until ice retreats beyond the Northwest Passage, allowing direct access to Europe. Mr. Chopra said shipping rates have been low for several years but are beginning to rise. Higher rates will make it viable for them to run the short route between Europe and Asia. The other problem with melting is that multi-year ice is coming into shipping channels. This ice will have to melt or be grounded before shipping opens up because it is stronger than steel.

Issue Papers Breakout Summaries

Kim Hall reported out on the breakout session discussion of the issue paper on AI and automation as related to emergency response. They developed an outline for moving forward. She will rewrite the paper in the coming week, share it with the small group, then send it to the HSRP members and subject matter experts for review. They expected that the paper will be finalized at the next HSRP meeting.

Julie Thomas reported out on the sea level rise issue paper breakout discussion. They found it challenging to determine how broad to make the paper, as it is hard to talk exclusively about the work being done in the three offices without tying it in to the bigger picture. They came up with a good start but needed more time to flesh it out.

CAPT McIntyre reported out on the Arctic issue paper breakout discussion. They reviewed the paper that was essentially an update of a previous Arctic Priorities paper from 2015. They discussed how to reorganize it and focus more on areas where NOAA has the input to effect change. Other topics discussed included issues related to what Dave Maune proposed on small coastal communities. They were open to adding a sentence or bullet point within the paper addressing this issue.

Adjournment

The Panel stood in recess at 2:22 p.m.

Thursday, August 29, 2019

The meeting was called to order at 8:32 a.m.

Chair Saade and CAPT Kretovic welcomed attendees to the third day of the meeting and reviewed the day's agenda.

Day 2 Recap – Member Round Robin Discussion

Chair Saade called for the HSRP members comments on the previous day's proceedings. Members were impressed with the partnerships and potential of UxS for hydrographic surveying, but also found it helpful to see some of the limitations due to current rules and regulations. NOAA can hopefully work with other federal agencies to see the full use of the technology realized in a safe manner. UxS will provide an opportunity to generate enormous amounts of data, the question then becomes how best to apply the data to maximize the use of all the different public and private datasets and develop enhanced products. The importance of academic partnerships was made clear from the panelists and visiting the Port of New Orleans demonstrated the completely different problem sets that each port has. HSRP members appreciated NOAA's leadership on research, support for autonomous systems and helping them build capacity with the academic partnerships. The Panel noted the importance of collaboration within NOAA, ensuring all offices are using UxS safely, securely, and efficiently and continuing to work with emerging technologies.

Planning and Engagement Working Group Discussion continued

Julie Thomas led the discussion in continuing the review of the status for each of the topics in the matrix.

Rich Edwing discussed the status of the Operational Forecast System (OFS). CO-OPS is the operator of OFS hydrodynamic models that are mostly developed by CSDL. The models run on the high-performance computers at the National Centers for Environmental Prediction, where CO-OPS has a partnership with NWS and the output then goes to CO-OPS to incorporate in their products. Local Weather Offices are users of the output but there is not a direct link to them as part of this process. Mr. Edwing suggested hosting a webinar on the whole modeling program for the members, who could then decide where they want to go next with the topic. Ms. Thomas said that they should plan to do this during one of the next Planning and Engagement calls. Mr. Edwing said the HSRP could be helpful in advising on new capability and outreach and engagement, starting to build confidence in the forecast data. There is a San Francisco Bay model and it is coming up for a refresh/modernization.

Ed Kelly said the HSRP needs to either use a different name for the matrix or prioritize the topics. Dr. Maune suggested changing the title of the matrix to "Issues Matrix", which was accepted. Dr. Kelly still thought they should spend some time prioritizing, based on what is relevant to locations for future meetings.

Chair Saade suggested adding the issue of getting near-real time data collection processing from ASVs to the end users. NOAA and the HSRP need to challenge the ASV developers to do this.

CAPT Kinner asked if NOAA could play the role of a central clearinghouse that could help improve coordination across all of the parties working on autonomous technologies. Chair Saade said UNH does this in some ways, for partners that are willing to let them know what they are working on. Dr. Maune said they need to allow the competitive marketplace to function. Developers hide what they are doing to gain competitive advantage over others and it does bring out the best of the industry by not having a central control. Dr. Kelly said the IOOS Regional Associations have helped in academia in particular to ameliorate this issue.

Chair Saade proposed including recreational issues as part of the Hawaii meeting, since it has been a while since the HSRP discussed the issue. CAPT Kinner agreed and commented that small boat users have no clue what all is available to them. CAPT Chopra said the Lone Star Harbor Safety Committee has a very successful outreach and engagement program that the HSRP could look into. CAPT Page said

mariner magazines are a good forum for getting information to different types of users. CAPT Kinner said that each of the magazines having their own niche is part of the problem, since they don't speak to each other. An educational push is needed to inform users of available resources and changes coming that will affect them. CAPT Brennan said that this is the goal of the precision navigation project – getting all of the data available and usable for everyone, packaging everything NOAA does in a user-friendly way on a navigational app. Much of the time they are spending on doing this development is simply to make sure that it is readily consumable by a whole host of developers. Vice Chair Thomas said the Marine Exchange of Southern California is another useful resource in getting information to boaters.

CAPT Kinner commented that the issue of tech-minded developers creating tools without having any first-hand knowledge of boating is an issue. Bringing them into the picture to help them understand what users are looking for could be beneficial. Lynne Mersfelder-Lewis said the list of topics for the Hawaii meeting is already very full, but they will take everything into consideration.

Galen Scott, Program Analyst, Geoscience Research Division, NGS, NOS, NOAA, presented on the 2022 NSRS modernization that will take advantage of improvement in surveying and mapping technology and accuracy, with new tools and models being made available to better serve communities in regions experiencing land motion, such as subsidence or uplift. The NSRS includes longitude, latitude, elevation, gravity, and shoreline position and allows users to measure changes over time. NGS is tasked with defining the NSRS, maintaining it, and providing access to it. Currently, two datums, the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88) underpin the NSRS. Mr. Scott focused on the elevation aspect of the NSRS, since the way water flows is the primary concern of the HSRP. The modernized NSRS will be active and will include four terrestrial reference frames that are based on the tectonic plates, replacing NAVD 88 with the North American-Pacific Geopotential Datum of 2022 (NAPGD 2022) to account for how things move through time. Mr. Scott provided an overview of how the NSRS works, how it was developed, and some applications of its data. After Hurricane Katrina, NGS realized that passive survey controls were insufficient for highly dynamic environments. In 2004, NGS began working with the State of Louisiana to conduct GPS surveys that provided more accurate current positions. This advanced the idea that this needed to be done everywhere. Global Navigation Satellite Systems (GNSS) are a main driver behind this, as GNSS equipment is fast, inexpensive, and reliable and it reduces reliance on finding survey controls in order to start a survey. GNSS is insensitive to distance-dependent errors and immune to benchmark stability. GNSS eliminates systematic errors in current datums, aligns NSRS to the International Terrestrial Reference Frame, and integrates both the horizontal and elevation components into the NSRS. The modernization will provide 2cm heights pretty much anywhere. In today's NSRS, a height is held fixed until replaced; moving forward, the modernized NSRS will provide estimates of crustal motion from the Intra-Frame Velocity Model of 2022 (IFVM 2022). This will give GPS observations over time, as well as error bars to give users a sense of the accuracy of the observations and a model projecting positions into the future. The IFVM will be used to move coordinates through time from the date of the survey to a Reference Epoch (2020, 2025, 2030 etc.) so that surveys conducted at different times can be related to each other. NGS also has a large citizen science crowdsourcing campaign to collect GPS data on survey control benchmarks in order to get the data they need to create transformation tools.

HSRP Q&A

Chair Saade asked how accurate the SAR measurements are. Mr. Scott said the power of SAR is measuring changes over time down to submillimeter-scale changes. Its accuracy depends on the number of satellite passes you have. There are only so many SAR satellites operating and they operate in different ways, but Mr. Scott's understanding was that they do monthly passes. NGS is creating the system to process the data and align it all together, but the observations that are required to be submitted to them need to come from partners, such as states or other federal agencies. This is a big issue, because if people are not submitting new data, then what NGS is publishing is what they got last. They need advocates for

this effort. Ms. Blackwell said they are working with the National Society of Professional Surveyors regularly and utilize NGS' 14 Regional Geodetic Advisors for outreach. NGS is partnering with USGS and NASA to use SAR technologies to help them with relative changes over time. One of the key things they need to be able to do is to make the relative absolute by connecting SAR to the NSRS through the CORS network, Foundation CORS in particular.

Dr. Maune said SAR is good for things beyond the millimeter level, such as tracking subsidence across the country. He has seen instances of lidar datasets not fitting together by two feet because of subsidence rates. What NGS is doing is vital for keeping track of how things are changing.

Chair Saade asked how quickly NGS could update specific locations, such as following an earthquake. Mr. Scott said that, because they have active controls running 24/7 and feeding the data back to their office, they can see the changes pretty quickly. Getting the information uploaded into their tools and models takes more time.

Addressing NOAA's Existing and Potential Subsidence and Sea Level Rise Services for Hydrographic Services

Julie Thomas, HSRP Member, and Audra Luscher, Coastal Hazards Program Manager, NOAA, introduced the panel and moderated the discussion on subsidence, the challenges and changing risks from sea level rise, and the critical observations and data from NOAA and partners needed to understand the impacts on communities, navigation services, and the constraints of the current planning system. Speakers addressed gaps and offered suggestions for how NOAA can direct its finite resources to enhance safe, efficient, and environmentally sound maritime operations.

Nicole LeBoeuf, Acting Assistant Administrator, NOS, NOAA, provided an overview of the topic the panel would be addressing. Small Louisiana communities are at risk of both episodic events, like hurricanes and floods, and chronic events, like sea level rise and subsidence. No coastal communities are immune from these events, and they will all need to adapt. Providing information about coastal change so that others can adapt is quickly becoming one of NOAA's top priorities. The products of NOS offices are essential to governments, industry, and the public understanding coastal change, and those programs are playing an increasingly critical role in supporting coastal resilience. Though a relatively mild hurricane, Hurricane Barry caused a seven foot storm surge costing \$500-900 million in damage. High tide flooding can happen on calm, sunny days, and these elevated water levels can disrupt communities and crucial infrastructure like septic and stormwater systems. NOS is combining its scientific, technical, and resource management expertise to deliver tools to coastal communities that will help mitigate the impacts of the future as well as providing advisory services. August 29 marks the 14th anniversary of Hurricane Katrina's landfall. The region continues to recover from the loss of life and devastation from that historic storm. Ms. LeBoeuf shared poignant images captured by photographer Ed Richards and asked for a moment of silence in honor of those whose lives were lost or were forever changed by the hurricane.

Clifford J. Mugnier, CP, CMS, FASPRS, Senior Instructor, Department of Civil and Environmental Engineering, Louisiana State University; and Chief of Geology, Louisiana Spatial Reference Center, Center for GeoInformatics, chronicled the research of subsidence in Louisiana and support for the geoid model in 2022. NGS studies beginning in the 1970s found significant subsidence in southern Louisiana. Following catastrophic rain events in New Orleans, FEMA complained to the Justice Department about the amount of money they were paying out in insurance. The local parishes and every professional land surveyor in metro New Orleans were co-named in a lawsuit for \$96 million. Some of the parishes authorized and paid for densification of leveling networks in metropolitan New Orleans, and in the early 2000s, USACE asked to update everything to NAVD 88. Because of the lawsuits, Jefferson and St. Bernard Parishes established new benchmark systems along with other benchmarks installed by NGS in Plaquemines and Orleans Parishes. Mr. Mugnier and his students at the University of New

Orleans also conducted relative gravity surveys of all of the benchmarks, which NGS accepted and incorporated into the NSRS. NAVD 88 data began being published in 1990, except for southern Louisiana because it was recognized to be a crustal motion area. Absolute gravity measurements taken at the University of New Orleans in 1989 and 1991 showed the area was getting closer to the center of the earth by 0.91 cm a year. In 1996, the Defense Mapping Agency awarded a \$1 million contract to recompute the recently declassified GEOID model. GPS provided ellipsoidal heights, but not elevations. The shape of the earth in terms of mean sea level is a mathematical model called the geoid – the surface of the ocean as a mean of the tides as well as what it might represent inside of the continents. The difference between the geoid and the ellipsoid is the geoid height. Having the ellipsoidal height from GPS and subtracting the geoid height gives the orthometric height, or elevation. These are the elevations that NGS provides, and each year they incorporate more gravity observations from the air, satellite, and ground observations to enhance the quality and knowledge of the geoid in the U.S. NGS publishes them as iterations of the GEOID model. Congress asked NGS for the best solution to continuing forward in the future and in 1998 NGS released its National Height Modernization Study which recommended using the geoid and GPS to get reliable elevations in the U.S. Congress accepted this as the best way to proceed forward with current technology. Southern Louisiana is very concerned about subsidence, and LSU is installing CORS throughout the state and collecting observed absolute gravity at many locations. Subsidence occurs throughout Louisiana in different places, at different rates, and at different times. Absolute gravity observations since 2002 show changes of -49mm at Alexandria and -9mm at Ruston. In addition to absolute gravity, they will be measuring deflection of the vertical at all 54 Louisiana stations and at tide stations throughout the Gulf of Mexico. LSU supports 31 national CORS sites across the state.

Dr. Rick Luettich, Alumni Distinguished Professor and Director, Institute of Marine Sciences and Center for Natural Hazards Resilience, University of North Carolina at Chapel Hill, discussed information needs to properly assess and manage risk in coastal cities, such as New Orleans, that lie close to or below sea level. The coastal modeling community is comprised of the academic community, mission agencies who are interested in hazard assessment and mitigation design, and the private sector and non-governmental organizations who provide specialized expertise to support governmental sectors and businesses that do not have in-house capability. The ADCIRC Coastal Hazard Modeling System is used by many agencies, institutions, and private companies. It is also the basis of NOAA's VDatum calculations. It started as a storm surge model/coastal circulation model driven by tides and meteorology, and they have added in wave properties and are working on adding freshwater to be able to better model hazards in the coastal zone. Louisiana is one of the most complicated places for modeling. Greater New Orleans is in a particularly bad position, being mostly below the Mississippi River, Lake Pontchartrain, and Lake Borgne. Because of its position, a complex system has been constructed to try to keep the water out. This makes modeling especially challenging, requiring place-based model implementation. To apply any of these models in the coastal zone, they have to know what the ground elevation is relative to various datums throughout the entire region. When Dr. Luettich first started working in New Orleans, he was working with datasets referencing different datums from different times which led to significant misalignment and required extensive work to remedy. It has gotten much better and NOAA has been the primary driver of this, for which the community is grateful. His priority list of things that NOAA should continue to provide for the modeling community included: up-to-date coastal bathymetry and topography integrated into a seamless dataset; well-defined coastal datums tying water and terrestrial elevations; a robust coastal water level gage network with both historical and real-time availability; and interagency collaboration on products and services in coastal waters and inland waters. NOAA products and services are needed for the continual assessment of risk reduction systems around Greater New Orleans to determine if they still provide the expected protections and, if not, what improvements are needed given relative sea level rise, levee settlement, and climate-related change in storm statistics. They also assist authorities during storm events to operate risk reduction systems and make evacuation and other emergency response decisions.

Renee Collini, Program Coordinator, Northern Gulf of Mexico Sentinel Site Cooperative, Mississippi-Alabama Sea Grant, Mississippi State University, provided a summary of feedback from science, service, and stewardship stakeholders in the northern Gulf of Mexico on the ability of current NGS, CO-OPS, and OCS resources to address sea-level rise questions and needs. The NGOM Sentinel Site Cooperative works to bring together resources that Gulf stakeholders need to address sea level rise, as well as facilitating a productive conversation around sea level rise. Ms. Collini queried three groups – extension and outreach, coastal decision makers, and researchers – to find out what NOAA products and services they use and how. Aerial imagery, sea level projections, and historical water level trends were used heavily by those doing outreach. Decision makers rely on Tides and Currents information for operational purposes, including utility authorities that use these projections to know when to look for potential sewer overflows so they can document the problem in order to get resources to address it. Researchers use much of the same data, but refer directly to the tide gage data, datums, rates of sea level rise for siting as well as utilizing post-analysis information, NGS services, and on-the-ground advisors. Data needs cited by these groups included: sea level rise observation infrastructure gaps (NWLON and CORS), contextualized and connected datasets (subsidence data with tide gage data, coupled aerial imagery with tide gage observing data), and nearshore coastal aerial imagery in “non-priority” areas. Around one-third of those queried wanted case-specific help, and not always more tools. Before building a new tool, NOAA should look to fix or improve existing ones. Providing improved organization of current resources and technical support, as well as leaning on existing outreach and extension services are ways to improve NOAA’s offerings. NGOM developed a tool called Gulf Tree that brings together available climate resilience tools for the Gulf of Mexico and developed a resource that uses five questions to narrow down from 109 available tools to those most likely to be relevant to meet each user’s needs. It then provides a brief summary plus strengths and limitations of the tools to see which will best suit the user’s purpose before they invest time and money in it. This has been a very successful approach to organizing the process. Partnerships should focus on information delivery by socializing the data and information, as well as communicating the science clearly. The CO-OPS technical report on global and regional sea level rise scenarios for the United States was much-needed information, but was not readily consumable for most people. The Sentinel Site Cooperative distilled the information into a series of locally-specific easily understood two-pagers with local curves, projections of high tide flooding, exceedance probabilities, and tips and tools. These were very effective in structuring meaningful conversations informed by the best available science, and as a result this data has been integrated into restoration projects, planning efforts, and sea level rise communication around the country.

Brian Lezina, Division Chief, Planning and Research, Louisiana Coastal Protection and Restoration Authority, discussed how Louisiana is using current and predicted data to understand present and future conditions to implement the state’s multi-billion dollar coastal restoration and protection program. CPRA is the single state entity with the authority to articulate a clear statement of priorities to achieve comprehensive coastal protection and restoration for Louisiana. Their mandate is to develop, implement, and enforce a comprehensive coastal protection and restoration master plan with a goal of moving the state towards a more sustainable coastline to protect its citizens and preserve critical habitats. It is a 50-year, \$50 billion plan that integrates a robust science-based approach for things like hard structure protection versus restoration. The challenge is planning viable projects while envisioning what the area will look like 50 years hence. They carry out this work through the broader lens of the goals of Louisiana’s Coastal Program which includes flood protection, restoration of natural processes, protection of coastal habitats and cultural heritage, and maintaining the working coast. Key NOAA products include: water level information; bathymetry; salinity, temperature, altimetry; relative sea level rise; and atmospheric information. People across the state are staking their futures on the information CPRA provides and their ability to outreach and put into action all of these data points. Future efforts should include cooperatives like the Ecological Effects of Sea Level Rise Program, increases to real-time monitoring and sampling frequency, improved coordination across data platforms, and specific NOS-led teams to interrogate sea level rise data.

Windell Curole, General Manager, South Lafourche Levee District, provided an overview of the improvement in measuring water elevations and land movement in a subsiding delta. After 39 years as manager of the Levee District he believes that GPS elevations have been by far the greatest technological improvement in their work and for the survival of southern Louisiana. Every inch matters in a subsiding delta and without flood protection, nothing else matters. Everything they are doing today is 20 years too late. Since 1930, southern Louisiana has lost land equivalent to the size of Delaware. Mississippi River flood protections have deprived the land of the sediment deposition and replenishment that it has traditionally relied upon, but the state is trying to address this. The land loss combined with subsidence has led to the Gulf of Mexico being ~30 miles closer to New Orleans than it was 50 years ago. This means hurricanes and tidal prisms are more powerful than ever. South Lafourche Levee District is 30 miles south of New Orleans, but due to their good work and good luck they are the only district that has not flooded from any storms since 2000. Sea level rise in southern Louisiana is a major issue, but subsidence is the controlling factor. Single line surveys used to take three months, cost \$100,000 and would still be inaccurate by about a foot and a half. With GPS, they can cover the whole system in a couple days with incredible accuracy, get the data out, and it only costs \$8,000. It is invaluable for the work that needs to be done in southern Louisiana. The state is losing ~35 square miles of land a year. Subsidence, induced by both natural and anthropogenic causes, is the main contributor to this land loss. Most of the subsidence is caused by the loading of the modern Mississippi River delta on the edge of the North American lithosphere. The accumulation of several hundred feet of sediments since the last ice age has pushed the southern edge of Northern America downward causing the Earth's lithosphere to bend. The footprint, or load, of the delta is in southeast Louisiana; however it is causing subsidence in areas as far away as northern Louisiana, eastern Texas, Mississippi, and Alabama. Compaction of delta sediments is also causing subsidence, as well as water and oil withdrawal from shallow wells. Since there are direct and indirect negative effects of subsidence on wetlands, coastal Louisiana is especially vulnerable to land loss. Wetlands loss from subsidence is caused directly by increased inundation from relative sea level rise. Indirectly, salt water intrusion kills salt intolerant vegetation. Barrier islands and wetlands are subjected to increased wave action and erosion from coastal storms and hurricanes. There is evidence of approximately one foot of subsidence between 1982 and 2002 along LA Highway 1 from Raceland to Grand Isle, Louisiana, which is the primary evacuation route for the area. Water level and datum information are critical for assessing subsidence, sea level change, and shoreline, and are essential for emergency preparedness, navigation, and identifying at-risk infrastructure.

HSRP Q&A

Dave Maune asked if the panel members were familiar with the 3D National Elevation Requirements and Benefits Study asking stakeholders what they need in terms of inland topography, inland bathymetry, nearshore bathymetry, and offshore bathymetry. He asked if they would be willing to fill out the questionnaire. The panelists were eager to contribute and agreed to pass it along to other stakeholders. Mr. Lezina said CPRA assigns an economic value of the expected annual damages if they did not get that information, which is in the billions. Ms. Collini suggested sending it to the other four Sentinel Site Cooperative coordinators around the US.

Sean Duffy commented that there are many users of the waterways around southern Louisiana that all have different interests. Viewing it as a working coast means different things to the navigation industry than it does to the fishing communities. The Big River Coalition, with the help of CPRA, has secured funding to increase the beneficial use of dredge material, and they expect to have restored 10,000 acres below Venice, Louisiana, by the end of 2019. In a changing landscape, increasing the beneficial use of dredge material can provide a lot of restoration affordably if used close to where it is dredged. Though everyone is trying to work together, that which may benefit restoration efforts may hurt navigation, fisheries, or other stakeholder groups. As precipitation increases, these problems will continue to be exacerbated.

Rich Edwing asked Dr. Luettich if he felt he had enough water level information to be assimilated and accurately drive his models and if there is anything that would significantly improve the performance of the models. Dr. Luettich said they are very grateful for the hardening of the tide stations, which have been holding up much better. He was not sure where exactly more stations are needed. Their biggest challenge now is making the connection with the land and the hydrology. Modeling those processes is becoming more important as they are seeing more precipitation and land-falling events. Penetrating inland with those gages to make that connection may allow them to do a better job in that area.

Vice Chair Thomas asked about the response to outreach efforts with the public in southern Louisiana. Mr. Curole said it is too apparent to Louisianans not to be believed in; what they don't understand is why it is happening. There may be too much talk about the warming climate and not enough about subsidence. Even with an abundance of jobs, Louisiana is losing people on its coasts because they can't have an everyday dry existence. Leesville, Louisiana, used to have 100 families; now only six people live there. Ms. Collini said it is very place-specific. In southern Louisiana, subsidence is the dominant factor, while in other Gulf Coast states, sea level rise is dominant. NOAA's tools help to have data-informed conversations, but it is important that it is about the place and the people you're working with. Mr. Lezina said people do see it, but not to the full extent of the problem, only as it affects them directly. They need to be able to envision 50 years from now. Dr. Luettich said that there has been very effective messaging in Louisiana about subsidence and land loss. The Flood Protection Authority in Louisiana feels like it struggles with messaging and keeping people well-informed. This is a constant battle.

Nicole LeBoeuf said that location-specific information is critical. One of the issues NOS is grappling with in terms of tools is what their role is versus people on the ground who may understand how to message in a more tailored way. Communication hand-off is important and needs to be quick, seamless, and tailored to the audience without giving different messages. This takes a lot of work. Mr. Curole said to make sure that the message matches what people see on the ground. Once everyone is talking the same language and can see what the locals see, then the message can get across.

CAPT Kretovic asked about the requirements Dr. Luettich may have for the nearshore mapping, specifically resolution needs for bathymetry both vertical and horizontal and across what depth range. Dr. Luettich said the most poorly represented areas in existing bathymetry are inside sounds and estuaries. Also, as you enter the surf zone things are changing dramatically. Keeping up with that is difficult, but important as you try to understand what the run-up of the water is associated with waves. There are many areas that, by virtue of lack of sampling or rapid change, have real challenges with bathymetry. Those would be his priority areas for bathymetry.

Public Comment

Dr. Qassim Abdullah, Woolpert, commented on issues associated with vertical datum. NAPGD 2022 will be the most accurate datum ever achieved. He asked if federal agencies would commit to migrating everything from low mean water, which is problematic and not as reliable as gravity modeling, and use one unified national geodetic reference. Ms. Blackwell said NGS hopes that by utilizing GNSS and taking ellipsoid heights, applying NAPGD 2022 will solve these problems. There is a lot of work that needs to be done in order to get to that point. What Dr. Abdullah described is the goal of NGS and will be the fruition of the National Height Modernization Program.

Thomas Davis, surveyor, said they have good tidal datums and good terrestrial datums, but what is lacking is where those two meet, namely the coastal area. This is especially true on the Mississippi River. On the CO-OPS website, all the gages in southern Louisiana are missing the NAVD 88 ties. This creates many problems on the surveying side. He asked if NOAA is working towards publishing those in spite of the known inaccuracy and whether VDatum is going to get more accurate. He also asked the panel if they are using VDatum or CO-OPS gages. Ms. Blackwell said NGS is working on providing an updated

geopotential datum because there are no good NAVD 88 heights due to the lack of observations. It is impossible to recreate all of the NAVD 88 benchmarks that were available in the past, therefore there can't really be an update to VDatum. We need new observations and a geopotential datum to replace NAVD 88. This is not going to happen quickly, but NGS is working on it, and they will continue to work with stakeholders through their Regional Advisors and geospatial modeling partners to figure out how to get additional observations to help make this better sooner.

Jon Dasler said keeping updates on passive marks is going to be a never-ending battle that ultimately may need to be abandoned. In the interim, having tidal datums relevant to ellipsoid heights published would be a great benefit. In response to Dr. Abdullah's comment, Mr. Dasler said there is a need for gradient datums and tidal datums for navigation and permitting purposes. Tying those together is critical for the surveying community.

Wendy French, GIS consultant, suggested issues that should be included in future HSRP meetings. NOAA's nowCoast was essential in the Hurricane Gustav preparation and response, and parishes that used their base maps received FEMA reimbursements quickly because they were able to track what happened and when. This documentation made the difference in being able to keep parishes out of bankruptcy. There is no way to figure out the impact that these new systems have had in being able to resolve problems that in the past have been beyond our reach. NOAA has a major role in policy and governance, as well as authenticating datasets. They are in a unique position to set up the right structure for how to bring in new datasets and let the private sector lead the way with authenticated data that decision makers, insurance risk monitors, stockbrokers, supply chain, and others can follow upon.

Renee Collini said a big need across Mississippi, Alabama, and northwest Florida is understanding how rising sea levels will reduce the capacity of stormwater systems, which are all gravity-fed. Research is needed to help quantify what that impact might be. It is a significant challenge moving from univariate hazards to multivariate hazards, considering them together and how they will interact with each other.

HSRP Working Groups Follow-up: priorities, issue papers, OCS Strategic Plan, recommendation letter, other

Julie Thomas read a rough draft of the HSRP letter to the Administrator and requested feedback from the Panel. Proposed topics included: continuous investment in establishing and maintaining the CORS network, particularly in the Mississippi River region; restricted visibility/fog sensors for navigation; supporting emergency response and sea level rise/subsidence studies; acknowledging the progress made on the topic of the Coast Guard's effort toward AIS; the continual advancement of PORTS; support for efforts to expand 3D Nation; hydrography in support of the White House's increasing interest in the southwest Pacific as an area of key strategic importance, including the search for rare earth elements; expanding multibeam surveys in the Mississippi River delta; congratulating RDML Gallaudet on his Chairmanship of the CMTS; and the HSRP's willingness to be help in the White House Ocean Science and Technology Summit.

Chopra suggested splitting the letter in two and directing one to CMTS and one to NOAA.

Ed Saade suggested mentioning the 14th anniversary of Katrina's landfall, GPS benchmarking, volunteerism and advocacy, quotes from panelists, and how NOS OCS plays into critical minerals, deep ocean mining, and Seabed 2030.

Deanne Hargrave suggested including Port Fourchon, as the entire energy industry in the Gulf of Mexico goes through that port and the same issues they've heard about apply there as well.

Julie Thomas emailed the draft out to the members for their responses.

Julie Thomas and Lynne Mersfelder Lewis led a discussion of topics and logistics for the 2020 HSRP meetings in Honolulu, Hawaii, and San Francisco, California. Ms. Blackwell suggested including Regional Advisor Ed Carlson to give an overview of NGS activities around the Pacific. Could also tie this in to some of the needs NGS is trying to fill for the Pacific plate. CAPT Brennan said the NOAA ship Rainier is doing reef assessments in the Northwestern Hawaiian Islands, and the launches are doing hydrographic surveys around Maui and Molokai. There has been interest in NOAA taking a larger role in charting around the Pacific Islands, and looking at the volume of data in the Pacific Islands that needs to be mapped for Seabed 2030 it is a significant issue. Critical marine minerals are another topic. Nainoa Thompson, President of the Polynesian Voyaging Society, would be a good speaker for discussion about the history of Pacific voyaging and how it has been resurrected. Rich Edwing said the greatest value of the Pacific Island NWLON stations is in early tsunami warnings and as data points for global sea level rise. It would be good to hear from someone at the NWS Tsunami Warning Center in Honolulu. Ed Saade said their growing coastline may be interesting to hear about, as well as deep ocean mining and renewable energy industries. CAPT Chopra said the Marshall Islands have been very active at IMO and the UN, and may be worth inviting to see how NOAA can support them. Vice Chair Thomas said Melissa Iwamoto, director of PacIOOS, may be able to schedule a board meeting during the same week HSRP is there so they could get stakeholders from Guam and the Marshall Islands. CAPT Brennan said there is a national security angle that could be pertinent to the meeting. CAPT Chopra noted that Par Pacific is the sole oil supplier for the islands. Ms. Hargrave suggested inviting Tom Reed from Oceanic Imaging Consultants to talk about bringing data quickly from acquisition to being usable information.

San Francisco topic ideas included: sea level panel with Dr. Patrick Bernard from USGS Santa Cruz and Leslie Ewing from the Coastal Commission; a tech sector presentation on AI, Internet of Things, UxS, and other applicable technologies; and USGS mapping partners.

Suggestions for future meeting locations included 2021 meetings in Puerto Rico and Chicago; 2022 in Savannah and a mid-Atlantic meeting, such as DC. CAPT Kretovic said that the lack of representation at the last DC meeting gave her pause about going back too soon and suggested other mid-Atlantic locations like Baltimore, Philadelphia, or New York for getting input from local stakeholders.

The Panel voted unanimously to approve the draft issue papers, recognizing the possible need for minor edits, and agreed they should be sent with the letter to the Administrator.

Gary Thompson said they are reformatting the Emergency Services issue paper with a focus on AI. This will be available soon and will be sent to members, to be approved in Hawaii.

Vice Chair Thomas added Alaska coastal mapping to the issues matrix for an issue paper. This will be pending until further discussion at the Hawaii meeting.

Lucy Hick, OCS, discussed the webinar series she hosts called NOAA Nav-cast and invited the HSRP to participate or recommend any subjects for future Nav-casts. The Planning and Engagement Working Group will coordinate and get more information out to the Panel.

Meeting Recap and HSRP Round Robin Closing Comments

Sean Duffy made some closing comments reflecting on the lasting impacts of Hurricane Katrina on the area and in his own life. He reminded members that we all win and lose as a team.

Kim Hall, who will be rotating off the Panel before their next meeting, said she has enjoyed her time on the HSRP and seeing their progression to being a well-oiled machine. She encouraged participation through rotating leadership of the working groups. Chair Saade said he will be stepping down as Chair of the HSRP and succession will be discussed in upcoming meetings.

Next Meeting

The next HSRP meeting will be April 27-29, 2020, in Honolulu, Hawaii.

The meeting was adjourned at 3:23 p.m.

HSRP VOTING MEMBERS IN ATTENDANCE:

Capt. Anuj Chopra	Vice President – Americas, RightShip
Sean Duffy, Sr.	Executive Director, Big River Coalition
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
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, Vice 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 PRESENT:

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
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Nicole LeBouef, Ph.D.	Deputy Assistant Administrator, National Ocean Service, NOAA
Captain Elizabeth Kretovic	Acting Director and Deputy Hydrographer, Office of Coast Survey, NOAA
RDML Shepard M. Smith	Acting Deputy Director, National Ocean Service, NOAA; Director, Office of Coast Survey, NOS, and HSRP Designated Federal Official
Juliana Blackwell	Director, National Geodetic Survey, NOAA
Richard Edwing	Director, Center for Operational Oceanography Products & Services, NOAA
NOS AND NOAA STAFF PRESENT:	
Lynne Mersfelder-Lewis	HSRP Program Coordinator
Mike Aslaksen	Remote Sensing Division, NGS
Glenn Boledovich	Policy Director and Chief of Policy, Planning and Analysis, NOS
CAPT Rick Brennan	Chief, Hydrographic Surveys Division
Christine Burns	OCS
Virginia Dentler	CO-OPS
David Ermisch	NOS
Jeff Grashcal	NWS
Grace Gray	CO-OPS
Lucy Hick	OCS
Audra Luscher	CO-OPS
Amanda Phelps	OCS
Denis Riordan	NGS Regional Manager
Suzanne Van Cooten	NWS
Chris Van Westendrop	Chief, Navigation Services Division, OCS

SPEAKERS:

Paul Aucoin	Port of South Louisiana
CAPT Michael Bopp	Crescent River Pilots Association
Thomas Chance	L3/ASV Global (retired)
Brandy Christian	Port of New Orleans and Public Belt Railroad Corp.
Renee Collini	Sea Grant
CAPT Brian Connon	University of Southern Mississippi
Windell Curole	South Lafourche Levee District
CAPT Stephen Hathorn	NOBRA Pilots
Dr. John G.W. Kelly	NOAA
Matt LaGarde	Ingram Barge
Brian Lezina	CPRA
Dr. Rick Luettich	UNC-Chapel Hill
Audra Luscher	NOAA
CAPT Kristi Luttrell	US Coast Guard
LT Damian Manda	NOAA
CAPT Michael Miller	Associated Branch Pilots
COL Stephen Murphy	US Army Corps of Engineers
Lt. Gov William Nungesser	State of Louisiana
Tim Osborn	NOAA
Jackie Pettway	US Army Corps of Engineers
Neeraj Saraf	NOAA
Galen Scott	NOAA

Dr. Michael Starek

Texas A&M

Mike Steenhoek

Soy Transportation Coalition

Stephen White

NOAA

Mark Wingate

US Army Corps of Engineers

Craig Winn

NOAA

Darren Wright

National Marine Program Leader, Marine, Tropical
and Tsunami Services, NOAA

ATTENDEES (In Person):

Name	Affiliation
Qassim Abdullah	Woolpert
Kurt Allen	QSI
Craig Andrews	C&D Port Solutions
Matt Borbash	Deputy Hydrographer of the Navy
Davie Breaux	Port Fourchon
Molly Bourgoyne	DOTD-OMC
Samantha Bruce	R2Sonic
Pat Chambera	USACE
Jerry Clower	Harbor Towing
Kim Dailey	Teledyne
Jon Dasler	David Evans and Associates
Thomas Davis	Lanier & Associates
Dave Easter	US IOOS
Richard Entwistle	USACE
Zach Finn	EGR
Wendi French	
Michelle Ganon	Port of New Orleans
Charles Goodhoe	ERG
Bill Hanson	Great Lakes Dock and Dredge Company
Melissa Jeansonne	Fugro
Tim Killeen	Louisiana DNR
Barb Kirkpatrick	GCOOS
Darius Lapeda	Fugro
Brian Lezina	LCPRA
Daniel Maher	USACE New Orleans
Matthew Malphurs	DOTD-OMC

Dickie Martin	Fugro
Chris McHugh	Terrasond
Michael Miller	
David Mooneyhan	USM
Michael Nation	Harbor Towing
Mike Nitska	Hydroterra
Andrew Oakman	USACE
Marcus Ogle	Fugro
Andy Orthmonn	Terrasond
Matt Paulson	Saildrone
Bill Purvis	Thoma-Sea Marine
Steve Raber	QSI
Michael Redmayne	CARIS
James Rizzo	TAMUCC
Ryan Scully	Crescent Pilots; MRTIS
David Skansi	C&D Port Solutions
Nadine Slimak	GCOOS
Jim Stark	GICA
Tarice Taylor	NOAA OCM
Jan van Smirren	Ocean Sierra
Michael Sullivan	USACE
Mac Wade	PAMC
Nathan Wardwell	JOA Surveys
Dallon Weathers	T&T Braveheart

ATTENDEES (via webinar):

Andy Armstrong, Co-Director, University of New Hampshire-Joint Hydrographic Center; HSRP Non-Voting Member

Straud Armstrong

Deborah Bland
Samantha Bruce
Donald Darling
Hollis Europe
Jeffrey Ferguson
Joseph Gallegos
Matt Gipson
Elizabeth Hausman
Russel Hyatt
Michael Jarvis
Nathan Junius
Greg Laiche
Sean Murphy
Ed Myers
Guy Noll
Percy Pacheco
Vital Pradith
Carlos Prieto
Steven Riley
Amanda Rodriguez
Mark Ryan
Jan van Smirren
Erin Weller
Marian Westley
Daniel Wright
Richard Zarrella