

Meeting Summary
Hydrographic Services Review Panel
March 3-4, 2021
Webinar

Wednesday, March 3, 2021

On the call of the Designated Federal Official (DFO), Rear Admiral Shepard M. Smith, NOAA, the Hydrographic Services Review Panel (HSRP) meeting was convened on March 3, 2021, via webinar. The following report summarizes the deliberations of this meeting. The agenda, presentations, and documents are available for public inspection online at

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

Opening and Introductions

Ed Saade, Chair, HSRP; Group Director, Americas Region, President, Fugro USA, called the virtual meeting to order at 12:48 p.m. and asked for HSRP members and NOAA leadership to introduce themselves. This will be Chair Saade's last HSRP meeting as Chair; Julie Thomas is the incoming Chair and Sean Duffy will serve as Co-Chair. Chair Saade congratulated RDML Shep Smith on his retirement and RDML (Sel.) Rick Brennan on his selection as the new Director for OCS and HSRP DFO. Chair Saade remarked that NOAA and their contractors have done an outstanding job continuing their operations over the last year despite the challenges of the COVID-19 pandemic.

Rear Admiral Shepard Smith, Director, Office of Coast Survey, and HSRP Designated Federal Official, said it has been a pleasure to serve alongside Chair Saade. He congratulated Julie Thomas and Sean Duffy on their new roles on the Panel, as well as RDML (Sel.) Brennan for his new position at OCS. He thanked everyone for the extraordinary progress the HSRP has made in the last few years. Their approach to advising NOAA has inspired many within the agency to keep raising the bar for what they can accomplish. The HSRP meetings have been increasingly well-attended and the depth of engagement between the members, NOAA leadership, and the public has been instrumental in NOAA's effort to improve their hydrographic services.

Rear Admiral (Select) Rick Brennan, Director (Select), Office of Coast Survey, and HSRP Designated Federal Official, congratulated RDML Smith on his retirement. He and NOAA leadership agree that in-person meetings are the right course for the HSRP, though the fall 2021 meeting will still need to be held virtually. He recognized NOAA staff colleagues and stakeholders who have experienced prolonged electrical blackouts in Texas and throughout the South due to extreme weather. He congratulated the U.S. Committee on the Marine Transportation System (CMTS) and their supporting partners on their 15 year anniversary. Their work serves as an exemplary interagency collaboration that has helped keep the marine transportation system moving forward. The CMTS has always been a proponent of the work of the HSRP and the committees look forward to another 15 years of working together. 2021 also marks the 30th anniversary of the Physical Oceanographic Real Time System (PORTS) program, which now serves over 40 ports in the U.S. Rear Admiral Brennan thanked Mr. Duffy for putting together a series of meetings titled "Making Sense of Sensors," which did a great job of bringing together disparate federal agencies and stakeholders to extract additional value from federal

products and services. He thanked the HSRP and public commenters for their input on the National Ocean Mapping, Exploration, and Characterization (NOMECE) plan and Alaska Coastal Mapping Strategy (ACMS). NOAA is looking for new HSRP members to join the Panel by January 2022 and applications are due by April 26, 2021. Members were encouraged to reach out to Lynne Mersfelder-Lewis with candidate recommendations. RDML (Sel.) Brennan reflected on the passing of former HSRP member Larry Atkinson, who pushed the Panel and NOAA to keep sea level rise and resilience as high priorities in the work. He expressed his condolences to Dr. Atkinson's family as well as to Dr. Maune's for their recent loss.

U.S. Representative Charlie Crist, Florida's 13th Congressional District (via prerecorded video), said he has witnessed first-hand the role that NOAA plays in protecting the nation while serving as Vice Chairman of the Appropriations Committee on Commerce, Justice, and Science, and as a member of the Committee on Science, Space, and Technology. Investing in better technology is one tool at our disposal for saving coastal communities from the impacts of climate change. Technologies such as improved ocean mapping will allow decision-makers to better prepare coastal communities for sea level rise and catastrophic storm surge. Recent storm impacts could have been much worse without the continued efforts of NOAA and their partners in the Tampa Bay region. This includes collaborating with the University of South Florida (USF) to establish the Center for Ocean Mapping and Innovative Technologies (COMIT) to advance research on methods and technology for ocean mapping. Floridians are grateful for this effort and for the HSRP's support to their way of life and local economies.

Ben Friedman, Deputy Under Secretary for Operations, performing the duties of Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator, said the pandemic has made the last year extremely challenging for NOAA but he has been consistently amazed at the employees' abilities to carry out the agency's mission. Though there have been struggles in some areas, NOAA is moving forward, getting ships out, and bringing data in. This is Mr. Friedman's second time as Acting Administrator, having served for about nine months during the previous administration transition. His primary role is to assist with the transition into the new administration, which always means a transition in tone, people, and priorities, and this time is no exception. Gina Raimondo has been confirmed as the new Secretary of the Department of Commerce. She was previously the Governor of Rhode Island and has a keen interest in NOAA and its mission. As many as 15 new political appointees will eventually come into roles at NOAA; four have already started, but, to date, no appointed positions requiring Senate confirmation have been filled.

The new administration's key priorities for NOAA include climate, scientific integrity, and racial equity. Climate change is impacting everything NOAA does and is a major concern for the nation as a whole. President Biden has issued two executive orders on climate change: one to review current policies and ensure they are environmentally friendly and the other to create a National Climate Task Force, on which NOAA will play a key role. It is clear that the work of the HSRP falls squarely within this set of priorities and the NOS offices play a critical role in understanding the effects climate change. Mr. Friedman challenged the HSRP to think creatively about ways that NOAA can do better in addressing climate change, whether through new technologies or methodologies to reduce the agency's own carbon footprint, or that of mariners and the shipping industry. The Biden administration has also released a memorandum calling for a review of all scientific integrity policies throughout government. Two independent studies of actions taken during the so-called "Sharpiegate" incident following Hurricane Dorian found violations of NOAA's scientific integrity policy and the agency has been working hard to address these issues. Racial equity is also one of the principal priorities for the new administration, which is impacting all government missions in a number of ways. NOAA will be assessing whether it is a diverse agency that promotes inclusiveness and whether it provides its services in a racially equitable way. The HSRP can play a role in ensuring that NOAA is providing services equitably everywhere, including to traditionally underserved

communities. HSRP's input on NOAA's approach to recruiting new talent in hydrographic services would be welcome.

Operating the NOAA fleet during the previous year has been very challenging and has impacted NOAA's mission. Many partners have provided data and hydrographic services to fill gaps where NOAA has not been able to provide these services. The agency is in the midst of recapitalizing its fleet and has the first two ships under contract. These are Class A AGOR ships, which are research vessels; Class B, or hydrographic vessels, are the next in line. The agency hopes to have draft requests for proposals out in the coming weeks.

Nicole LeBoeuf, Acting Assistant Administrator, National Ocean Service, NOAA, said the last few weeks have been very busy at NOAA as the agency continues its operational mission while also welcoming a new presidential administration. The agency's capabilities and reputation as a science agency positions them to be a leading contributor to the new administration's agenda on climate change, racial equity, economic recovery, and scientific integrity. Core products from NOS' program offices will be fundamental to this effort. The economic impact of the nation's navigation infrastructure on the U.S. workforce and maritime commerce is enormous. In her discussions with the new policy team at NOAA, Ms. LeBoeuf has conveyed that any infrastructure jobs or economic recovery initiatives coming from the Executive Branch should include the maritime sector. The maritime sector is more important than ever in the ongoing effort to combat climate change and as part of the long process of post-pandemic economic recovery. The HSRP is a critical partner for NOAA, providing valuable recommendations and advice on their navigation and resilience missions. Its input on NOMEAC influenced the drafting of the implementation plan. NOS had hoped to have the ACMS implementation plan out for public comment by the time of this meeting, but the new appointees at the Office of Management and Budget and White House Office of Science and Technology Policy asked them to pause its release so they could become more acquainted with its contents. A new, bipartisan bill was recently introduced to Congress on ocean mapping, exploration, and hydrographic services that would codify NOMEAC, reauthorize the Ocean and Coastal Mapping Integration Act, and make technical corrections to the Hydrographic Services Improvement Act.

Congress has provided \$628 million for NOS in FY2021, \$2 million of which is an increase for ocean mapping and coastal charting relative to NOMEAC and ACMS. Overall, this represents a 3.6% increase from NOS' FY2020 enacted budget and is the largest regular appropriation in NOS' history. This increase reflects the acknowledgement that Earth's conditions are changing and the change is accelerating along our coasts and in our oceans, posing risks to all coastal communities and infrastructure. Ports and the industries and economies associated with them are too big to fail. NOAA must continue to provide the navigation services required in order to move goods and services in and out of the nation in order to help rebuild our economy. As the new administration seeks to build back better, one crucial component will be building back more resilient coastal and port communities.

Flash Updates: Opportunities and Challenges for NOS' Navigation Services Portfolio

Nicole LeBoeuf moderated the panel and introduced the speakers to discuss NOAA's navigation services portfolio in support of "seamless data," including the coastal data and information systems to support planning for resilience to climate change.

Rear Admiral (Select) Richard Brennan, provided an update on the NOMEAC implementation plan and OCS priorities. OCS' internal ocean mapping plan metrics address each of the objectives laid out in the NOMEAC strategy. This was by design and came about through the close collaboration between OCS and the NOMEAC Council. NOMEAC is seeking to map unmapped seafloor within the U.S. Exclusive Economic Zone at one measurement per 100 square meters resolution. As of January 2021, these unmapped waters

account for 53% of U.S. coastal, ocean, and Great Lakes waters. This represents one percentage point of progress since January 2020, which is not nearly adequate enough to complete the work by the goal of 2030. OCS has discontinued its paper nautical chart production. Paper charts are still an important tool for mariners, but OCS is transitioning their production system to better service their primary product, which is electronic navigational charts (ENCs). NOAA's new process will still allow for easy production of paper products through print on demand vendors and OCS will be hosting workshops in the coming months to build this out. OCS has a new data gateway that displays S-111 surface currents and is underlaid by the National Bathymetric Source data. This will also be the portal through which OCS delivers machine-readable products and services directly to a ship's bridge. RDML (Sel.) Brennan concluded by providing a brief overview of the locations for the 2021 hydrographic field season.

Juliana Blackwell, Director, National Geodetic Survey (NGS), provided the update on NGS' recent activities. The National Spatial Reference System (NSRS) modernization effort is a major update that will support the need for accurate and improved access to data, models, and tools for positioning, surveying, mapping, charting, and the integration of geospatial data and applications. The NSRS and coastal mapping that NGS provides are the foundation upon which coastal resiliency is measured. NGS currently provides accurate heights for flood risk determination, a consistent reference frame to enable disparate vertical measurements to be accurately related to each other, and shoreline change based on decades of consistently collected shoreline data. In the modernized NSRS, coordinates will provide time-dependent information about geodetic control and coastal communities, which will support time-dependent flood maps more rigorously than NGS' current standard practice of providing reference epoch coordinates. Once complete, the modernized NSRS will help coastal communities understand how their flood risks are changing over time. Last year, NGS announced a delay of at least two years for the roll-out of the modernized NSRS due to operational setbacks related to COVID-19 and other constraints. NGS will be hosting their 2021 Geospatial Summit virtually on May 4-5, where they will highlight changes to the three blueprint documents that guide the NSRS modernization effort. NGS' airborne gravity collection project, Gravity for the Redefinition of the American Vertical Datum (GRAV-D), is the basis for the new geopotential datum. Data collection has been impacted by the pandemic, but the teams now have safety protocols in place to ensure the safety of personnel and are once again collecting GRAV-D in limited areas, with reduced productivity. To date, NGS has collected 84.23% of their GRAV-D goal. Another component of the NSRS modernization effort is the upgrade of NOAA's Continuously Operating Reference Stations (CORS) Network. A revised comprehensive plan for the CORS program is in progress and NGS has contracted with UNAVCO for station repairs and upgrades, and it has expanded its reliance on federal partnerships to establish a set of Foundation CORS. NGS is currently collecting data from 26 of the 36 Foundation CORS. One area of expansion for NGS is the addition of CORS data into NOAA's Big Data Program. CORS data and NOAA's emergency response imagery are now available on Amazon Web Services' cloud platform. The ACMS implementation plan is currently under review by the new administration and will be available for public comment once it is approved. It incorporates the recommendations made by the HSRP through their white paper on ACMS. Across the U.S. and its territories, hurricane supplemental funding is being utilized to acquire topo-bathy LIDAR data and aerial imagery, and to update shoreline in impacted areas. LIDAR and imagery updates from Hurricanes Harvey and Irma have been completed and are publicly available. Datasets from Hurricane Maria should be completed and available by the end of 2021. Acquisitions for Hurricanes Florence and Michael and Typhoon Yutu are complete and NGS is currently performing QA/QC on the data, which will hopefully

be available publicly by the end of 2021. FY2021 internal and contract projects focused on increasing the safety and efficiency of NOAA hydrographic operations by collecting topo-bathy LIDAR from the nearshore to laser extinction. NGS has ongoing coastal mapping projects in Hawaii and others planned for Alaska and Virginia. NGS has been in the process of upgrading their camera system with RGB and NIR cameras in a single opposing alignment on a rotating mount that provides 123° field of view and supports onboard near-real-time positioning.

Richard Edwing, Director, Center for Operational Oceanographic Products and Services, provided the update on CO-OPS' long-standing mission area of coastal resilience. CO-OPS' suite of products and services were designed to support safe and efficient navigation, but their ability to do this pivots off the same observing systems, data, and data management systems that support their resilience mission. This holds true for NGS and OCS as well. Monitoring sea level trends has taken on increased importance as the public has become more aware of the impacts of climate change. CO-OPS offers expertise in addition to its data, working with a variety of stakeholders to help them build their own guidance documents on sea level rise. These stakeholders include the U.S. Army Corps of Engineers (USACE), the Department of Defense, and Miami-Dade County, among others. CO-OPS is a member of the Global Sea Level Observing System and 27 of their NWLON stations are the U.S.' contribution to the global effort to determine global sea level changes and ensure consistent measurements. CO-OPS' Coastal Inundation Dashboard (CID) is their flagship product for the resilience community, pulling in past, present, and forecast data. Improvements to the CID include: moving to a dynamic spatial product integrating inundation data; using flood thresholds for real-time inundation alerts and tracking of changing high tide flooding due to sea level rise; integrating historical products like sea level rise trends, extreme water level, and Top 10 information. It is the platform for the Next Generation Storm Quicklooks and they will be expanding service to the Great Lakes in FY 2021/22. CO-OPS will be using National Weather Service (NWS) thresholds to understand inundation at weather and climate timescales in order to trigger real-time water level alerts and monitor and track annual exceedances. CO-OPS has a five-year plan to build out the dashboard to include more climate timescale-oriented information. Over the past five years, they have begun outreach on the impact of sea level rise on tides through the Quarterly High Tide Bulletin and the High Tide Flooding Annual Outlook. CO-OPS is exploring improved data visualization capabilities by leveraging improvements in coding, data automation, and cloud migration. They have been working to improve support to stakeholders on coastal resilience, particularly by providing technical assistance tools and trainings. Improvements to CO-OPS' observing systems include: storm-resilient infrastructure, co-location of continuously-monitoring Global Navigation Satellite System (cGNSS) with NWLON to improve foundational data on vertical land motion, cGNSS tide buoys to support improved charting and mapping of coastal inundation, and a user needs assessment to support wave observation measurement requirements. CO-OPS is working to integrate with federal, state, and local networks to increase the density of available information and coastal inundation products and services and to display water level information in tools like the CID. CO-OPS is in the process of responding to congressional requests for a National Coastal Flood Information System.

Larry Mayer, Co-Director, Joint Hydrographic Center, University of New Hampshire, provided an update on the uncrewed vessel SAILDRONE Surveyor and activities at the Joint Hydrographic Center (JHC). The JHC competed and was recently awarded a renewal of their cooperative agreement with NOAA. They are now also part of the new ocean exploration Cooperative Institution and received a National Ocean Partnership Program (NOPP) grant for testing and applications of the SAILDRONE Surveyor. Dr.

Mayer provided a brief overview of some of the uncrewed vessels the JHC has been doing research and development with and some of the locations they have worked in. In addition to these sea trials, the JHC has been developing a launch and recovery system that can be used for a number of platforms. The Sairdrone Surveyor is a 72' uncrewed vessel with a wide range of capabilities, including a series of acoustic systems for both deep and shallow water, fisheries sonars, and a full suite of environmental sensors. The system should be able to be deployed for six to nine months or even longer, operating 24 hours a day. The Surveyor has been undergoing sea trials in recent weeks in San Francisco Bay, which have thus far been successful. Using a remote operating system, the Surveyor's data and performance are being monitored from UNH as well as other partner locations. They have been able to conduct a plethora of remote system checks, including for noise, laser extinction, roll and pitch, as well as implement initial patch tests. When the tests are complete, they will begin their first mission with the Surveyor in Hawaii, which will also present an opportunity to use the new Gap-Filler tool for optimal route planning. Research is underway at JHC to develop the technology necessary to make uncrewed systems truly autonomous. JHC and the Center for Coastal and Ocean Mapping (CCOM) entered the Virtual Ocean Robotics Challenge that challenged teams around the world use a virtual vehicle to navigate a series of obstacles autonomously. Their team won and took the lessons learned from the exercise to create a simulated environment to better understand the behavior of vessels. They are currently working with a prototype system with a six camera array that is geo-stabilized to provide a 360 degree view of the surroundings, full resolution sent to onboard object detection algorithms, and a reduced version sent back to the operations center. This is a big step toward reducing the telemetry bandwidth while retaining high operator situational awareness. This will eventually tie in to their augmented/virtual reality projects.

Dr. Steven Murawski, Director, Center for Ocean Mapping and Innovative Technologies (COMIT), University of South Florida, discussed the center's research, education, and public dissemination joint venture between NOAA, OCS, and the USF College of Marine Science (CMS). The cooperative agreement with NOAA has many priorities, including extending mapping capabilities and promoting collaboration among relevant NOAA line offices, addressing national mapping priorities via the NOMECS strategy with ancillary benefits to global mapping goals, and the development of academic programs. COMIT is housed within CMS, which is located in downtown St. Petersburg, home to the largest collection of marine scientists in the southeastern U.S. Dr. Murawski gave brief overview of the history and accomplishments of CMS. COMIT's mission is to benefit a diverse constituent base by evaluating and implementing cutting-edge technologies for coastal mapping in order to to maximize efficiency and support the goals of the NOMECS and the Seabed 2030 initiatives. Priority areas include uncrewed systems, geodetic observations, applied hydrography, high resolution modeling, professional development, and community outreach. Long-term goals for their research areas include: (1) vehicle, sensor, and software evaluation and development; (2) refinements to hydrodynamic modeling; (3) engagement with hydrographic community stakeholders with an eye towards building personnel capacity to expand data processing capabilities; (4) developing graduate/professional education opportunities and expanding ocean mapping workforce to better include underrepresented communities; and (5) advancing data collection methods to measure more of the ocean as areas and volumes versus lines and points. One of COMIT's current projects is prioritizing the mapping of an area of Florida's Gulf Coast called the Big Bend. It is a very shallow area, so they are looking to utilize uncrewed systems for mapping portions. Other activities underway include integrating multibeam sonar into uncrewed systems, enhancing geodetic observations, using applied hydrography for coastal and disaster response, forecasting and

remote sensing technologies, and teaching and outreach. Dr. Murawski briefly described each of these and highlighted some of the partners they are working with.

Coastal Data and Information Systems for Resilience

Nicole Elko, HSRP Member; Science Director, American Shore & Beach Preservation Association, and Audra Luscher, Resilience Program Manager, Center for Operational Oceanographic Products and Services, moderated the panel and introduced the speakers. NOS' information systems and data serve as the fundamental backbone for coastal resilience requirements. NOS products aid communities responding to sea level rise, coastal flooding, inundation, and climate issues.

Mark Osler, Senior Advisor for Coastal Inundation and Resilience, National Ocean Service, provided opening remarks. Sea level rise, dramatic shifts in Great Lakes water levels, subsidence, and damage from high tide flooding and storm events are severely impacting coastal communities, economies, and ecosystems, as well as threatening national security. Billions of dollars of critical infrastructure are at risk and the outlook for the future is even more severe. U.S. annual high tide flooding has more than doubled due to rising sea levels, with coastal communities expected to see 25-75 days of high tide flooding a year by 2050. Our societal response to these threats requires accurate and authoritative data, modeling, mapping, and services that quantify and convey the drivers of flood risk and improve our understanding of present and future risks at the coasts. A whole-of-government approach is needed to address the issue, and policy decisions about improving coastal resilience must be informed by those who will be most impacted by the policies in question. There are critical coverage gaps in NOAA data and services that NOAA is working hard to address. Coastal resilience has emerged as a vital, but secondary, demand on the NOS programs already tasked with a navigation services mission. Both of these missions rely upon a common set of technology, observations, modeling, datums, and a nationally coherent spatial reference system. One area where the HSRP could make an important contribution would be to develop and communicate this shared narrative and to affirm the importance of these programs and the support they need for their distinct but closely related mission areas.

Katrina Wyllie, Operations Team Lead, National Bathymetric Source, Operations Branch, Hydrographic Survey Division, Office of Coast Survey, presented on the National Bathymetric Source project, which uses hydrographic quality metrics when merging bathymetry from disparate sources to determine the best available data. This next generation of navigation products is currently being tested at the Port of Los Angeles-Long Beach, where the National Bathymetry is loaded into portable pilot units (PPUs) to support specific navigation needs. The data-driven workflows, with automation at the forefront, increase the quality, accessibility, and timeliness of source data. To make data-driven workflows effective, they need to have each data source's quality metrics available. The minimum metadata that should be captured for every survey includes depth, quality, and origin. A survey's horizontal and vertical datums are fundamental to an accurate derived product. The National Bathymetry product can support expanding and updating datum transformation models. Because of the changeability of the seafloor, it is important to ensure the source metrics are available to downstream users. Allowing survey quality to decay in time and space allows for the possibility of lower quality data to supersede higher quality data in highly changeable areas. Bathymetry is important to users beyond its navigation purposes; it is also important to the public, science, and industry. Accurate elevation models enable engineers and coastal zone managers to make informed decisions on dune stabilization, beach nourishment, dredge disposal

siting, and in building structures like groins and sea walls. Having accurate bathymetry with metrics clearly identified and appropriate datum handling are critical for models. Ms. Wyllie provided the following recommendations for the HSRP to consider: (1) educate downstream users of bathymetric quality factors to support appropriate use; (2) generic datum transformation needs to be made more accessible to the public; and (3) the Coast Survey Hydrographic Health model of temporal and spatial change is needed.

Hilary Stockdon, Science Advisor for Coastal Change Hazards, U.S. Geological Survey, presented on collaborations between NOAA and the U.S. Geological Survey (USGS) to provide forecasts of the total water levels at the shoreline and the expected coastal change resulting from the total water levels. She focused on the importance of defining a clear need, understanding the unique expertise needed to address the question, and the importance of strong collaboration. Because of the complexity of coastal issues and the scale of the problems, there is no way any one agency could do it all alone. USGS relies on collaboration between experts from various organizations to address these challenging questions. Models describing the interactions between coastal processes, morphologic evolution, and ecosystem change are used with high resolution observations of water levels, waves, elevation, and land cover to understand and forecast how coastal environments will respond to future storm conditions and provide stakeholders with actionable information at a national scale. The Operational Model for Total Water Levels is a collaboration between USGS and NOAA to develop and validate an operational forecast system for total water levels along the coast that includes tides, wind surge, and wave run-up. It predicts the magnitude, timing, and duration of water level impacts and provides operational predictions that can trigger local coastal change warnings for all storm events. The NOAA Nearshore Wave Prediction System, which includes USGS total water level and coastal change forecasts, is being implemented nationally. It is currently operational on the sandy coasts of the U.S. Gulf and Atlantic, and Pacific coast grids are under development. These projects have given USGS and NOAA an opportunity to pull together their unique but complementary expertise in this area in order to provide stakeholders with reliable and useful information. Going forward, NOAA will continue to implement models and use this information to issue guidance on hazardous conditions. USGS will lean heavily on NOAA's expertise on the delivery of products and interfacing with the public. Both groups will continue to require well-supported, sustained observational systems and will have to maintain their connection with the user community to ensure they are addressing their needs and providing information they can use in a way they can use it.

Nicole Kinsman, Alaska Regional Advisor, National Geodetic Survey, presented on the importance of a common and consistent geospatial framework to meet the economic, social, and environmental positioning needs of the nation. The NSRS directly benefits the public, with all federal agencies leveraging this shared framework in the context of coastal resilience. In places actively experiencing a lot of change, it is essential to be able to combine data from multiple sources and from multiple time periods with as much fidelity as possible. This is especially important at the coasts, which are not only areas of active change, but also where dynamic natural processes are intersecting with the built environment. The nation needs a spatial reference system that can serve these dual needs. NGS continues to fulfill its primary mission of defining, maintaining, and providing access to the NSRS, while also recognizing the need to modernize the system in tandem with advances in geodesy, geophysics, and technology, as well as to meet the evolving requirements and expectations of NSRS users. Decisions about the modernization of the NSRS must achieve a balance of improved consistency and convenience, while not departing from the expected characteristics that are part of how the nation utilizes the geospatial framework. Key features

of the modernized system are the primacy of GNSS-based access and time dependency. CORS stations serve as living benchmarks that allow NGS to monitor change through time at the ground surface, as well as to define the frames of the modernized NSRS and maintain mathematical relationships with the International Terrestrial Reference System (ITRS). The GRAV-D project is refining the gravimetric geoid model that enables GNSS-based access to geopotential datums. Without these two foundational elements in place, NGS could not fulfill its mission of maintaining or providing access to the NSRS. Time dependency is a game changer in the modernized NSRS and offers a better way to understand how the land is changing relative to the world around it. Dr. Kinsman discussed two NGS use cases, transitioning data and flood mapping, which allowed them to think more critically about how these changes are going to affect workflows. Her recommendations for the HSRP to consider were to: (1) advance NSRS modernization projects; (2) conduct outreach and education to prepare NSRS users; and (3) continue to provide technical assistance to the Federal Emergency Management Agency (FEMA) and other partners to explore full leveraging of the time-dependent NSRS features through data-driven case studies.

Gary Thompson, HSRP Member; Deputy Risk Management Chief, and Chief, North Carolina Geodetic Survey, North Carolina Department of Public Safety, presented on North Carolina's Flood Inundation Mapping Alert Network (FIMAN), a novel approach to flood plain management with rain and stage gage data, flood inundation maps, flooding impacts, and alerts in real-time to support risk-based decisions. The program leverages vast investments in data and includes partnerships with local, state, and federal agencies. Depending on where gages are located, FIMAN uses different types of communication: at the coast they use NOAA's GOES Satellite, inland they use cell modems, and in the mountains they use radio repeaters. FIMAN's engineers have developed pre-computed inundation libraries from LIDAR elevation data, engineering surveys, and other sources so that the system does not have to compute everything in the moment. FIMAN also has a web tool that efficiently communicates the data to the user. The FIMAN dashboard displays current conditions, providing the most recent inundation extent for each of their gages. Some gages also offer scenario and forecast information. Looking at real-time flood impacts allows users to see which buildings were impacted by inundation, by how much water, and what the estimated numerical damages may cost. The FIMAN-T was developed through a partnership between North Carolina Department of Emergency Management (NCEM) and the North Carolina Department of Transportation and is a web-based tool that provides stakeholders with real-time and forecasted flood inundation depths along roadways, bridges, and other transportation assets. NCEM has recently partnered with NOAA to upgrade six of North Carolina's gage sites to NWLON standards and co-locate their gages with new CORS stations. North Carolina is currently in the process of installing 71 new gages to add to their network and they will be partnering with USGS and other agencies as they add local gages to towns and cities across the state. Their goal is to have a gage in every community that has at least a 1% chance of flooding

HSRP Q&A

Julie Thomas asked Dr. Stockdon if she has been in contact with Patrick Barnard, who works on USGS' Coastal Storm Modeling System. Dr. Stockdon said they are working with Dr. Barnard and the USGS team in Santa Cruz, who have started a USGS-wide programmatic focus on coastal change hazards, making sure the different science centers are connecting their work.

Public Comment

Denis Hains commented that, with respect to the diversity, equity, and inclusiveness priority, it is understood that NOAA and OCS strongly support the International Hydrographic Organization (IHO) Assembly-adopted "Empowering Women in Hydrography" initiative. He asked if there were targeted actions that NOAA and OCS will commit and deploy to engage in this specific initiative during the coming years during the U.N. Decade of Ocean Science for Sustainable Development, and specifically in collaboration with the U.S.-Canada Hydrographic Commission. John Nyberg, OCS, said that OCS has a letter of support for IHO's gender diversity initiative and will be providing no-cost professional development opportunities for up to three women in the hydrography field per year.

Bob McConnaughey asked if there is an anticipated completion date for GRAV-D collection in Alaska. Galen Scott, NGS, said that all of mainland Alaska is now complete and NGS expects to collect the final portion of the Aleutian Islands in the next couple years.

Alan Leonardi said he was pleased to see the success of the Sairdron from the Ocean Exploration and NOPP funding.

Regarding Dr. Murawski's presentation, Ashley Chappell noted that the Big Bend work is an OCS-IOCM campaign project and Mark Luther commented on his role in the local management of Tampa Bay's PORTS.

Denis Hains commended Ms. Blackwell for her presentation and the impressive work NGS has accomplished. He asked if the new NSRS geopotential datum will include the integration of a continuous vertical datum surface representing the lowest astronomical tides chart datums used for hydrographic and electronic navigation charting. Daniel Roman responded during the following day's public comment period below.

John Kelley asked Dr. Stockdon if the National Water Partnership System Total Water Level forecast system is for both extratropical and tropical cyclones and, if so, what NOAA storm surge model outputs are used for extratropical cyclones. Dr. Stockdon said that under normal conditions they use the Extratropical Surge and Tide Operational Forecast System (ESTOFS), and under hurricane conditions they use the National Hurricane Center's P-Surge model.

Chris Freeman commented that the NSRS modernization is exciting for those in the seamless topo-bathy shoreline monitoring field, however, there will be challenges for those groups collecting very long-term datasets that they have to go back and translate. North Carolina has a 22-year-and-running shoreline monitoring program with at least one post-storm dataset per year. They have had several adjustments over this time, from NGVD 29 to NAVD 88 and an update of the datum-derived shorelines with epoch changes, that have cost their partners considerable amounts of money. He asked if, as NGS works through the modernization project, there has been recognition of these specific challenges and how NGS might aid in developing additional workflows and/or grant programs to help. Dr. Kinsman said that they are incorporating lessons learned from the previous modernization efforts, but there are growing pains as they go through the process. One of the reasons for the delays has been that they want to be sure they are bringing in as much experience and feedback as they can from users to ensure the tools are in place to minimize the impact as much as possible. She invited Mr. Freeman to contact her about the local situation he referenced so it can be incorporated into their considerations moving forward.

Jon Dasler acknowledged the importance of Sentinel NWLON stations with co-located CORS and said that the Calcasieu Pass station in Louisiana was instrumental in their survey, allowing NOAA to reopen the entrance to Lake Charles following Hurricane Laura, which ended up being the only operational CORS station in the area after the storm. He encouraged NOAA's effort to continue co-locating CORS at NWLON stations wherever practicable. Mr. Edwing said CO-OPS recognizes the value of co-locating GNSS technology with their NWLON stations and they are working on it as resources allow.

Nathan Wardwell said that we know both land and sea level are moving, and so over time tidal datums become out of date and are no longer representative of the current sea level. This challenge seems like a great opportunity to leverage long-term water level and CORS data sets to develop a tidal datum epoch transformation tool for incorporation in VDatum. Doing so would reduce errors in VDatum transformations, improve storm surge modeling, and better align tidal datums with the NSRS modernization effort. Mr. Edwing said CO-OPS periodically updates their tidal datums to reflect the current sea level and are in the process of doing that now. If there is demand be able to transform between past tidal datum epochs, they could consider incorporating it into the VDatum tool, which currently does not have that capability. Ms. Blackwell said that they are trying to tie cGNSS and water levels together better; input on how that connection can be made more seamless would be of interest.

Recap and Round robin with HSRP Members and NOAA Leadership

HSRP members provided final comments on some of the highlights of the meeting. These comments included: the impressive rate of technological change in the field of navigation services and the improved decision-making support tools; members were pleased to hear that coastal resilience also includes subsidence; the importance of paper charts and need for improved outreach and education on the transition to ENC's; most of the hazards to navigation are happening in less than 40 meters of water and this zone needs to be a higher priority; NOAA should consider how they can be the fulcrum to create benchmarking and best practices/best products to expand and facilitate what is being done; nearly everything the HSRP has been discussing relates in some way to the development of offshore wind energy and this should be a topic for a future HSRP technical discussion; there can be a danger in forming too many partnerships that may restrict what developers can put out; disappointment in not seeing HSRP's recommendations clearly incorporated into the NOMEAC implementation plan; there is a lot that NOS offices are involved in and there is a danger of being pulled into too many directions, even away from what may be viewed as the priorities of each program; the HSRP may want to consider updating their white paper on sea level rise as a result of the day's presentations; federal agencies have gotten much better at zooming in to property scale maps that provide data collected at that resolution; there is a lot of detail in many of the products and work is needed to translate that down to something that is applicable to more users; hope that North Carolina's effort can expand to a national capability with the support of NOAA or FEMA. RDML Smith said he was struck by how the resilience conversation has shifted over the last few meetings from a description of the problem towards what solutions might look like. He looks forward to the HSRP continuing in this direction. Dr. Mayer was thrilled to see the successful partnerships between federal agencies, as well as with local governments and academia. He did not see the role of the private sector in coastal resilience addressed and he thought this would be worth discussing further. CAPT Armstrong said there are probably areas where the NOAA-USGS partnership could continue to grow, particularly in terms of NOAA's Hydro Health model and some of the wave observation information. He hopes the HSRP will explore some of those possibilities in the future. Chair

Saade said the issues of diversity, equity, and inclusion will continue to be a hot topic going forward. Coastal resilience is a major focus area for the private sector and it would be good to include them in future HSRP discussions, including on technology transfer.

Thursday, March 4, 2021

Round Robin Recap from Day One

Ed Saade reconvened the meeting and called for introductions and any additional thoughts from the previous day's meeting. CAPT Kinner said she would like to see a more emphatic push to get information out to all levels of the maritime community on the changes that are coming to charts and how they are produced. There have been problems with interference (including the hacking of GPS), AIS stations not properly transmitting information, and user ineptitude. More people need to understand how to use ENC's, how they are evolving, and what their vulnerabilities are. Mr. Thomson said he would like to hear more about a research division within NOAA that is using uncrewed aircraft to conduct shoreline monitoring after events. Ms. Blackwell asked the HSRP members to provide any specific suggestions on what they would like the NOS Program Directors to deliver presentations on in future meetings. Dr. Abdullah said that with the level of accuracy we are getting from mapping technology, we really need to consider a progressive national geospatial standard for coastal and oceanic mapping. He also mentioned the importance of precise navigation in restricted visibility conditions and he would like to see NOAA leading the effort to provide industry with a solution to this problem. Dr. Elko noted that "resilience" means different things to different people. She suggested that the recommendations from the previous day's panel could be incorporated into an update to the HSRP's white paper, letter to the Administrator, or packaged as general information. Mr. Gee said that private industry has flexibility and agility that NOAA should leverage to benefit the maritime community wherever they can. NOAA should also look to their expertise in transferring technology into use, as the private sector has a lot of experience and knowledge about customer needs and how best to serve them. Chair Saade said there is a need for NOAA to start to track sustainability goals and metrics, especially associated with advancements on autonomous platforms. There is also a major desire amongst many in the offshore wind industry to do data sharing with state and federal governments. Offshore wind development is all happening in less than 40 meters of water off the east coast and there will be a push to go as deep as 1200 meters on the west coast. Their issues overlap with HSRP topics in a number of areas. John Nyberg was excited that the HSRP highlighted how NOAA's foundational data impacts so many different disciplines. We are in a transformative era with regard to navigation and pulling it all together is the big challenge. RDML (Sel.) Brennan said the panel did a great job demonstrating the value of the navigation services programs in support of both coastal resiliency and marine navigation. RDML Smith thanked the HSRP for their input on the NOMECEC implementation plan. The NOMECEC Council spent a lot of time on their comment concerning the formalization of a structure that includes private sector, philanthropic, and academic organizations' input to the NOMECEC. Everyone involved believes there should be an open and active participation with each of these sectors, but they need to figure out how to do it effectively within the confines of the Federal Advisory Committee Act. Under the existing deadline, OCS decided they did not want to push forward with creating a new committee, but did want to include opportunities for public input and leave the door open for a formalized structure in the future.

Coastal Ocean Modeling in Support of Marine Navigation and the Blue Economy

Julie Thomas, HSRP Co-Chair, and Shachak Pe'eri, Chief, Coast Survey Development Lab, Office of Coast Survey, moderated the panel and introduced the speakers. NOS works on coastal and ocean modeling to conduct a wide range of research to broaden the scientific knowledge and to increase models'

predictability on existing and emerging coastal, social, and ecological sustainability and hydrologic issues. Modeling frameworks are employed to generate products supporting resilient communities and coastal economies.

Shachak Pe'eri and Pat Burke, Chief, Oceanographic Division, Center for Operational Oceanographic Products and Services, provided opening remarks. Dr. Pe'eri briefly reviewed NOS' modeling history since the 1990s. Its mission was, and still is, to develop real-time data-based nowcast and forecast models that can predict water levels and currents to support safe navigation. The models have been integrated into the PORTS system, which has one or more real-time water level gages and current sensors in each bay. The forecast model provides real-time data everywhere throughout each bay, as well as 24-hour forecasts. In addition to the shipping industry, the nowcasts and forecasts have been used by recreational boaters, fishermen, the Coast Guard, HAZMAT agencies for more efficiently cleaning up oil spills, and even for a variety of biological purposes, such as harmful algal bloom forecasts.

Mr. Burke presented the current view of ocean modeling at NOS. NOS has traditionally designed their models for navigation, and their outputs have been water levels, currents, salinity, and water temperature. They are now getting more requirements for building their capabilities out further. While navigation is still their primary mission, NOS is now designing their models with flooding, coastal resilience, ecology/water quality, and response operation applications in mind. Coincident with this, they also are actively developing efforts in data assimilation, ice forecasting, waves, and riverine-coastal interactions. Model development and operations are a collaborative effort. NOS recently hired a portfolio manager to coordinate the work being done within NOS and across NOAA. The modelers would like to hear feedback on whether they are hitting the mark, and they will continue to work with the HSRP and stakeholders to build a feedback system for what improvements might be helpful. At the end of March, NOS is delivering two new systems with multipurpose approaches in mind, one for the northern Gulf of Mexico and one for the West Coast.

Daniel R. Roman, Chief Geodesist, National Geodetic Survey, presented on planned improvements to reference frames and datums in the Pacific. He began with an overview of height relationships, describing the differences between ellipsoidal heights, orthometric heights, geoid heights, and local mean sea level, as well as the importance of having transformations between them. From these charts and VDatum transformations, mariners are able to ascertain their positioning and under keel clearance. Trying to fit this all together is sometimes more of an art than a science, but NGS is looking to move towards something more rigorous in the future through a sustainable and enhanced Global Geodetic Reference Frame. NGS' NSRS modernization efforts focus on how they will align their geometric coordinates, including ellipsoidal height and geopotential height tied into the geometric frame. For the western Pacific's geodesy needs, there are some available data sets that can be utilized, though more are needed. ITRF2014 is available and there will be an ITRF2020. The Pacific Terrestrial Reference Frame and Mariana Terrestrial Reference Frame will also be available at some point. NOAA's CORS network and the Asia-Pacific Reference Frame (APREF) have a series of sites where users can access the ITRF. There are global height models available through ICGEM, but EGM2008 and other similar models are emitting signals that make it difficult to provide the best resolution for geodesy in areas like Micronesia. Terrestrial and altimetric gravity data are used to enhance NGS' geoid height models. There is a very limited set of data available from NOAA CORS stations in the western Pacific in order to validate these models, so APREF stations are being added to the network to enhance coverage and accessibility. The Pacific Geospatial and Surveying Council is made up of national geospatial, hydrographic, and surveying authorities of Pacific Island countries and territories. They are counterparts to NGS and probably have a great deal of information that could be useful in filling data gaps.

Peter Stone, Technical Director, Center for Operational Oceanographic Products and Services, presented on S-104 and S-111 product specifications and NOS' coastal modeling efforts. He provided a general overview of NOS' Operational Hydrodynamic Modeling program as it supports marine

navigation. Having a modeling program operate within frameworks is important and makes products authoritative, consistent, and reliable, in addition to making their development efficient. He discussed one of these, NAO 216-105B, that NOAA adopted in order to increase the speed of research-to-operations. The framework follows unified modeling and community modeling standards and requires extensive stakeholder engagement to ensure the output of the model meets users' needs. The international framework for building models is guided by the IHO and will be the wave of the future. The S-100 product suite is a set of data standards that support a wide variety of data types and provides product specifications on formatting, encoding, metadata, and how data is delivered. This product specification effort is designed so that ships traveling internationally can work off of one common data set and seamlessly process data regardless of where they are in the world. Currently, S-104 (water level forecast guidance) is at Version 0.0.8 and they are expecting to get to Version 1 by the end of 2021, which will mean that the product specifications are in near-final form and can be distributed to stakeholders for feedback. S-111 (surface current forecast guidance) is at Version 1.0.1 and they are hoping to get to Version 2.0 by 2022, which will have user feedback incorporated and will be usable in operational contexts. NOS model outputs are disseminated in a variety of ways, including CO-OPS' Tides and Current website, IOOS' EDS Model Viewer, the National Center for Environmental Information's (NCEI) Model Archive, and NOAA's nowCOAST site and Big Data Project. The Big Data Project creates a single cloud-based repository for all of NOAA's data sets and helps remove obstacles to the public using that data. They hope that, with this access, private enterprise will make use of NOAA's data to build interesting tools that have not previously been considered.

Greg Seroka, Physical Scientist, Coastal Marine Modeling Branch, Coast Survey Development Lab, Office of Coast Survey, presented on NOS' operational ocean forecast modeling systems for navigational services. Coastal modeling is important for a variety of reasons, including providing information between observation locations and forecast guidance. Traditional tide tables predict tides, but not changes in water levels and currents due to wind, atmospheric pressure, rivers, et cetera. Operational coastal and ocean models provide local, official water level and surface current forecast guidance for marine navigation, coastal resilience, disaster mitigations, ecology, and fisheries science and management. The two main areas for operational ocean forecast models that NOS has developed and maintains are the Operational Forecast Systems (OFS) and the Global ESTOFS. NOAA's OFS models provide short-term nowcasts and 2- to 5-day forecast guidance for U.S. coastal waters and the Great Lakes on water currents, water levels, water temperature, and salinity. The Global ESTOFS is NOAA's operational storm surge modeling system for the world, providing both nowcasts and 7.5-day forecast guidance on water levels. The West Coast OFS and Northern Gulf of Mexico OFS2 will both be coming online soon. As part of the Precision Marine Navigation Data Processing & Dissemination System, OFS surface current forecast guidance is being encoded in formats following IHO S-100 Universal Hydrographic Data framework. One example of this is the S-111 surface current forecasts, which mariners can use to plan optimal routes and avoid hazards. NOS' Global ESTOFS model provides the highest resolution global surge forecast guidance today, and they are working on providing even higher resolution in key ports and improving model bathymetry and shoreline. One of the biggest challenges is that coastal ocean models are referenced to mean sea level, when datums such as mean lower low water or lowest astronomical tide are needed for charting and navigation. Global ESTOFS forecast guidance is being encoded in IHO S-100 formats so that mariners can use S-104 water level forecasts for improved route monitoring. Pacific Ocean enhancements to Global ESTOFS are an area of high national priority for the U.S. and will provide higher resolution and improved mesh in key areas, as well as improved bathymetry. The ocean model enhancements will provide not only water level forecast guidance but also surface currents for navigation in order to support under keel clearance and route planning for key Pacific ports.

Charles Seaton, Program Coordinator, Coastal Margin Observation and Prediction, Columbia River Inter-Tribal Fisheries Commission, presented on surface currents from depth-resolving computer

models in support of a wide variety of economic and environmental goals in areas of interest in the Pacific Ocean and Columbia River estuary. The Coastal Margin Observation and Prediction (COMP) program is a component of the IOOS Regional Association NANOOS and has been modeling the Columbia River estuary for over 20 years. They produce forecasts and long-term retrospective simulations using depth-resolving models to show salinity intrusion, fresh water plumes, and velocities throughout the water column. These models use a spatially-responsive mesh to allow resolution of complex features. COMP is part of a larger modeling community comprised of academia, non-governmental organizations, and state and Tribal governments that provides a test bed for model and application development. This community serves as a feed-in to NOAA operational models and has been utilized in a variety of NOAA projects. Support for the modeling community feeds back into NOAA operational modeling. Spatially-responsive modeling allows basin-scale and high-resolution features to be handled by a single continuous model. Depth-resolving modeling resolves surface currents, water levels, and density. This combination provides the potential for real-time port-to-port navigation support. These models will also support an understanding of basin-scale ecological processes.

HSRP Q&A

Dr. Roman responded to Denis Hains' question from the previous day concerning how ships tie to lowest astronomical tide, saying that if you have the datum transformations, then you have the ability to position the ship in that framework. Many nations are adopting the same types of reference systems on land, so it should work globally, not just in the U.S.

Qassim Abdullah said he is impressed with the dynamic under keel clearance (DUKC) model and asked if it is deemed safe to navigate a boat using it in conditions of restricted visibility. Dr. Seroka said the DUKC systems are primarily developed and operated by private companies, so he could not speak to the specifics. The S-100 standards have both under keel clearance and weather management standards. Visibility will be part of that system so that it can be integrated into the DUKC systems. Mr. Burke said they are looking at how to integrate NOS forecasts that have oceanographic variables with things like fog forecasts put out by local Weather Forecast Offices, especially in the Gulf of Mexico. They have the capability, and it is in use in Tampa Bay; NOS is looking to expand it to other Gulf ports. They will be happy to share some of their experiences as they closer to getting them online.

Sal Rassello said he was very impressed with these presentations and asked if these high resolution products extended to 80 meters of bathymetry off the coast. Dr. Pe'eri said the meshes that are used are derived from nodes taken from a bathymetry grid which is provided in high resolution where available and is sampled accordingly. Around key marine areas there is a high resolution of nodes but those are sampled at different resolutions depending on what model product they are looking at.

Sal Rassello also asked how all of this data will be displayed on the ECDIS, as it would be too much data for a mariner to read or listen to. Mr. Stone said that in the S-111 specifications, currents are downscaled to a 500 meter resolution, then there are different scalings based on how much a user is zoomed in to the chart. This is one reason why user feedback is needed, because these specifications were developed within an international organization of NOAA's counterparts, not necessarily by mariners. CAPT Rassello said NOAA should speak with the ECDIS makers to make the data more useful for mariners. Dr. Seroka said NOAA is working with the IHO and other hydrographic offices on interoperability and harmonization in the display so as not to overwhelm the mariner. NOAA's Precision Marine Navigation program is hosting workshops and gathering feedback from the user community to inform their way forward.

Ed Kelly said the granularity of the science involved in these models is amazing, but he believed that the challenge was going to be making this information digestible by mariners who need real-time decision support tools. The HSRP would like to find better ways to utilize NOAA's PORTS data, perhaps by

transmitting it over AIS. PORTS has become so user-friendly that it is now being utilized extensively by recreational boaters, coastal managers, academics, and many others, while still being overwhelmingly funded by a very small group of deep sea marine assets. He strongly suggested that the funding formula be revisited and/or nationalized.

Larry Mayer said JHC is looking at applying theories of human perception to address the issue of optimal visualization of this kind of information for mariners. He also asked if there is any interaction with the Navy Coastal Ocean Model or academic modeling efforts. Mr. Burke said there is some interaction with the Navy but one of the biggest challenges they had was the coordination of effort. Bringing Tracy Fanara onboard was a huge first step towards moving that partnership forward. They have been working hard on collaboration across the agency and working with IOOS Regional Associations. They are looking forward to the opportunity to have face-to-face discussions with more partners once it is safe to do so. NOS has a long-range vision of how they are going to collaborate to build an oceanographic enterprise for the nation. Mr. Stone added that the Navy and the National Geospatial-Intelligence Agency also have membership in IHO working groups and they bring their requirements and perspective to those discussions.

Lindsay Gee said interoperability is necessary but wondered how much that constrains what could be possible. This may be an area where PPU manufacturers have the flexibility to do other things that could be taken up. Dr. Seroka said they are designing S-100 for the ECDIS, but the idea is for the PPUs to follow on, so they will be part of the conversation. In the future, they may not do surface current portrayals and instead it will be integrated into the under keel clearance and route planning systems.

Anne McIntyre agreed with the comments made by other HSRP members and added that near-term forecasting is very important because it is what pilots use to plan for their next day or two of operations. She added that accuracy in conditions with very little under keel clearances is important, down to the inch or centimeter. There is a safety impact to ensuring you have enough water, but also an economic impact in getting the most out of what water is available.

Julia Powell, Chief, Navigation Services Division, and S-100 Working Group Chair, said NOAA's Precision Marine Navigation program is a cross-office initiative to get all of their data into formats that can be used across the spectrum of navigation systems. Currently, their outreach is focused more on PPUs because they can innovate more, while ECDIS is highly regulated. For under keel clearance, they have the water level and the water level forecasts to do adjustments, but the other key piece they need is high-resolution bathymetry. She said that she has had discussions on how to integrate real-time data feeds in a structured way so that it can be used by different types of maritime applications. Eventually they would like real-time data coming out of PORTS to be used to do in situ corrections on the bathymetric data. The S-100 Working Group has continued engagement with the larger ECDIS manufacturers and they are clear they do not wish to dictate to them how information should be portrayed.

Public Comment

Bob Moshiri said that another constituency that would tremendously benefit from accurate nearshore mapping is recreational fishers. Accurate bathymetry means they would find their favorite fishing holes easier and faster, driving less, and thus consuming less gas and reducing pollution. Getting families to leave their screens at home and spend time together outdoors is good for the health and well-being of Americans, especially with boating being a safe activity in the era of COVID and possibly future contagious diseases.

Bob Moshiri said that another important constituency that NOAA ought to consider as it surveys and develops nearshore data is the approximately 100,000 new boaters who are unexperienced and do not venture too far out from marinas and the shorelines. Bathymetry and accurate charts within the 40 meter

depth range is of paramount importance not just for safety of navigation but to make sure new boaters are happy partaking in their favorite pastime and comfortable returning to it.

Tony Cavell said that the best approach to the lack of understanding on many of the improvements is educational outreach through the speakers and educators who address these topics. Resistance to technological advancements out of inertia is, and will be, a significant hurdle for all. He added that "End User Clients" should be identified separately between "wholesale" versus "retail" users. Their needs in a product can be very different.

Rada Khadjinova asked about Ms. Blackwell's comment on NGS' plans for airborne LIDAR mapping in southeast Alaska and Virginia. Presumably, the work in Alaska will be in support of ACMS. She asked if these activities will include contractors, as articulated in the ACMS and as is the established practice with the vessel-based charting work for OCS. Ms. Blackwell said that the airborne gravity collection over the Aleutian Islands is part of the GRAV-D project that is underway. At this point, they are looking at a number of different aircraft that could be used to complete that work. There may be NOAA aircraft available but contract aircraft have been used during the GRAV-D collection and will continue to be used to complete that mission. NGS does intend to use contractors to do coastal mapping work as part of the ACMS, as well as doing some of that work in-house. A number of other federal and state entities are collaborating on this effort as well. RDML (Sel.) Brennan said OCS will have hydrographic contractors working in Alaska this summer responding to ACMS priorities.

Jon Dasler commented that VDatum is a valuable tool for the surveying and engineering community. There are many issues with the current VDatum models that should be addressed when updating to the new NSRS. Current models do not always align with CO-OPS tide stations that were not used in the model, models do not extend into ports or overlap nearshore areas for conversion of vessel or airborne LIDAR, ties to orthometric heights have inaccuracies and were adjusted from superseded data, et cetera. NOAA should consider use of other agency water level stations in the development/validation of VDatum. He asked if updated VDatum models going to be rolled out with the modernized NSRS. This coordination will be critical for the private sector for coastal engineering and coastal study efforts. Dr. Roman said VDatum ties to NAVD 88, which is off by over a meter in the Pacific Northwest from their local mean sea level. When they develop NAPGD 2022, they are tying it to about 200 tide stations to try to unify and find a geopotential datum that is the best fit to mean sea surface. First they have to roll out the modernized NSRS, but then incorporating this update into VDatum is something they believe will be critical.

Jon Dasler was also pleased to see the slide showing S-104 water levels DUKC on Columbia River. This gets to the issue that USACE surveys do not align with the NOAA VDatum model of mean lower low water over the Columbia River Bar. He asked if there is an effort to resolve these discrepancies to align chart datums between USACE and NOAA. RDML (Sel.) Brennan said they have been dealing with this on the Mississippi River and as they are building out the National Bathymetric Source. The thing they spend the most time on is ensuring they have the datums correct when they bring in data from the USACE. These are significant issues, particularly when talking about under keel clearances. They are working diligently with USACE to ensure that the way they attribute data is clear and correct and aligns with NOAA's definitions.

Guy Noll asked how the Water Resources Development Act (WRDA) of 2020 releases restraints on usage of the Harbor Maintenance Trust Fund for improving navigation services. He wondered if the HSRP has a role in addressing appropriate usage of these funds in supporting the information management of such programs as precision marine navigation, PORTS, and operational forecast models. Mr. Edwing said Harbor Maintenance Trust Funds are used almost exclusively for dredging projects. It would require legislation to open them up to other navigation uses, like charts or PORTS. Mr. Noll pointed out that there are several ports who contribute to the Harbor Maintenance Trust Fund but do not need continual

dredging projects to stay relevant to the blue economy; however, all ports need information services. As the goal of WRDA 2020 is to improve water infrastructure and includes feasibility studies for publicly-reviewed projects, it should also fund other information technology projects that support improved navigation services.

John Schneider said it is important to not focus solely on the PPU and pilots. The vessel masters must plan their voyage well in advance. This planning requires longer-range planning, and voyage planning is done primarily with ECDIS. The vessel is oftentimes loaded three weeks in advance.

Joyce Miller recommended that Dr. Abdullah review the existing HSRP issue paper entitled "Surveying and Charting in U.S. Channels, Harbors, and Anchorages" where they recommended that surveying to IHO standards be mandated and discussed why it was not happening.

Denis Hains asked if OCS has initiated work with local Arctic communities to involve them in crowd-sourced bathymetry contribution.

Steven Murawski commented, in regards to wind energy, that it is much easier to get concessions for access to observations for an industry that is not as "mature" as the offshore oil and gas industry.

HSRP Discussion: HSRP Priorities, Issue Paper, Working Groups, Other

Julie Thomas, HSRP Co-Chair, Planning and Engagement Working Group, led the discussion.

Arctic Working Group Update

Ed Page provided the update. Arctic maritime activity continues to increase and a study has been underway exploring the possibility of expanding the Port of Nome. The choke point for entering and departing the Arctic is the 42 mile wide Bering Strait, so transits here are used to benchmark Arctic activity. Total transits in 2020 were 550, which is the highest number recorded in at least the last decade. The Russian side of the Arctic is expanding even more rapidly, particularly with tanker traffic. Most of the traffic on the American side is tug and towing boats that supply the small Alaskan communities. A lot of work has been done to improve charting in the Arctic, and this has led to a traffic lane developing where passage is the safest. Though there is less of it, ice is still an issue in the Arctic waters and NOAA is active in this area. Deep draft vessel traffic is expected to grow in the Arctic and a lot of surveying work is underway to ensure safe transit when that becomes a more viable option for large cargo ships. The HSRP's issue paper on the Arctic and the recommendations contained therein are still relevant and being acted upon. CAPT Page highlighted some recent activities related to the recommendations made by the HSRP and he felt no changes were needed to the paper.

Proposed Modification to the HSRP Charter

Gary Thompson presented the proposed modification to the Panel's charter, which reads: "The HSRP shall provide advice regarding charts and related information for the safe navigation of marine and air commerce, and to provide basic data for engineering and scientific purposes and for other commercial and industrial needs as is set forth in Coast and Geodetic Survey Act of 1947 (33 U.S.C. §883 et seq.) in Section 33 U.S.C. §883a., Surveys and other activities." Anuj Chopra said the rationale behind requesting the change was that, as much interest as members may have in other issues, the HSRP should always have as its overarching focus facilitating commerce from U.S. ports, and that these activities should in some way add value to the nation. Lynne Mersfelder-Lewis noted that the three program offices most involved with the HSRP have overarching legislation from which the language was drawn. Gary Thompson moved to accept the amended charter as modified; the motion was seconded and approved unanimously.

Technical Working Group Update

Lindsay Gee provided the update on the working group's activities since the fall HSRP meeting. They drafted the HSRP's response to the NOMECE implementation plan, for which there is broad support from the Panel. In addition to its other benefits, NOMECE offers the opportunity for increased diversity and inclusion, as well as to address some of the historical colonial exploration in their approach to Pacific exploration.

Qassim Abdullah discussed some of the working group's discussions on restricted visibility and possible technological solutions. They are trying to figure out where the HSRP can contribute to finding a solution and whether there is enough industry interest to begin building something out. There will likely be a panel at the next HSRP meeting to present some opportunities in this space.

Deanne Hargrave discussed the burgeoning field of offshore wind energy and its areas of overlap with the blue economy and NOAA's missions. While a number of topics are being considered, she was not sure whether this will be taken up at their meetings or as a panel at a future HSRP meeting. Mr. Gee said they can hold working group sessions to gather information to provide to the HSRP in advance of having a panel on a future agenda. He added that other countries have been doing this work for a while and it could be helpful to get some of their lessons learned in order to mitigate potential barriers in the U.S. RDML (Sel.) Brennan said he views wind energy installations as incredibly well-designed and installed observation platforms. Exploring the opportunities there is an issue he regularly discusses with others in NOS.

Lindsay Gee said they have put off the subject of uncrewed vessels for a while, but it is probably time to take it back up and expand the topic to include autonomous vessels again.

Gary Thompson said that the working group is interested in receiving a presentation on GPS reflectometry, which could be used to help monitor water levels along the coast.

HSRP Member Discussion on HSRP Leadership, Priorities and Matrix, Issue Papers, and Other Topics

Sean Duffy will draft the HSRP's letter to the Administrator. He brought up the Jones Act component to some of the issues, which is a major consideration for the nation's ports but was not discussed during the meeting.

Meeting Recap & Round Robin with HSRP Members, Actions, and Wrap Up

Members shared their final thoughts on the meeting, including: datums are an issue the HSRP will need to continue to pay attention to; having a joint session with other FACAs on public-private partnerships, among other topics would be beneficial; the need to include traditional cultures in the discussion of low visibility navigation before the HSRP makes recommendations to NOAA; the HSRP did not vote on any issue papers at this meeting and this is an important output of the Panel; possible subjects for issue papers may include the technologies necessary for efficiently acquiring shallow water bathymetry; another potential topic for an issue paper or special session is how people have responded to the sunset of traditional raster charts and where gaps in public knowledge remain; the HSRP needs to recommend to NOAA that they find a way to become a lead agency in coordinating data production to create good standards and exchange capabilities; NOAA should be more aggressive in seeking out and involving IOOS and their Regional Associations in partnerships; NOAA needs to get deeply involved in offshore wind development; it is important to realize that in the nearshore area it is not just bathymetry that is lacking, but physical oceanographic measurements are also missing in many areas; the HSRP may make a future recommendation of applying the methods of the National Bathymetric Source project to other nearshore physical oceanographic measurements; the need to sell the NOAA brand and the HSRP to the public; and members expressed their gratitude for the service of both Ed Saade as Chair of the HSRP and RDML Smith as the Director of OCS and the HSRP DFO. RDML Smith said there are two ways that

NOS needs to be looking at sustainability: how they can do what they do in a more sustainable way and how their services can be tuned to help others do things in a more sustainable way. The HSRP should be exploring that and bundling their thinking under the banner of sustainability over the next few years. Dr. Mayer said presenting information to mariners in an easily understandable manner remains a challenge; parallel with that issue is how to optimally present the information to autonomous systems. Mr. Edwing said he was not sure NOAA had a good handle on reaching underserved communities and the HSRP may have input that could be beneficial. Ms. Blackwell said it may be worthwhile to highlight some of the things the program offices are doing related to diversity and inclusion.

Next Meeting

The next HSRP meeting will be held virtually in the fall of 2021.

The meeting was adjourned at 5:16 p.m.

HSRP VOTING MEMBERS IN ATTENDANCE:

Qassim Abdullah, Ph.D.	Vice President and Chief Scientist, Woolpert, Inc.; Adjunct Professor, Penn State and UMBC
Capt. Anuj Chopra	CEO, ESGplus LLC
Sean M. Duffy, Sr.	Executive Director, Big River Coalition
Nicole Elko, Ph.D.	Science Director, American Shore and Beach Preservation Association; Executive Director, South Carolina Beach Advocates; President, Elko Consulting
Lindsay Gee	Mapping and Science Coordinator, Ocean Exploration Trust
Deanne Hargrave	Geoscience Manager, Atlantic Shores Offshore Wind LLC
Edward J. Kelly, Ph.D.	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	Business Manager, San Francisco Bar Pilots
CAPT Ed Page (USCG, ret.)	Executive Director, Marine Exchange of Alaska
CAPT Salvatore Rassello	Director, Nautical Operations, Carnival Cruise Lines (ret.)
Edward J. Saade, Chair	Group Director Americas, President USA, Fugro Inc.
Julie Thomas, Co-Chair	Senior Advisor, Southern California Coastal Observing System; Program Manager, Coastal Data Information Program, Scripps Institution of Oceanography (ret.)
Gary Thompson	Deputy Risk Management Chief, and Chief, North Carolina Geodetic Survey, North Carolina

Department of Public Safety, Division of
Emergency Management/Risk Management

NOAA and NOS LEADERSHIP PRESENT:

Ben Friedman	Deputy Under Secretary for Operations, performing the duties of Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator
Nicole LeBoeuf	Acting Assistant Administrator, National Ocean Service, NOAA
RDML Shepard M. Smith	Director, Office of Coast Survey, NOS, and HSRP Designated Federal Official
RDML (Select) Richard Brennan	Director (Select), Office of Coast Survey, NOS, and HSRP Designated Federal Official
Capt. Andy Armstrong (NOAA, ret.)	Co-Director, UNH-NOAA Joint Hydrographic Center, University of New Hampshire
Juliana Blackwell	Director, National Geodetic Survey, NOAA
Richard Edwing	Director, Center for Operational Oceanographic Products & Services, NOAA
Larry Mayer, Ph.D.	Center for Coastal and Ocean Mapping and Co-Director, UNH-Joint Hydrographic Center, University of New Hampshire

NOS AND NOAA STAFF PRESENT:

Lynne Mersfelder-Lewis	HSRP Program Coordinator
Virginia Dentler	CO-OPS
John Nyberg	Deputy National Hydrographer, OCS
Amanda Phelps	OCS
Galen Scott	NGS
Jill Stoddard	OCS

GUEST SPEAKERS:

Pat Burke	Chief, Oceanographic Division, CO-OPS, NOS, NOAA
Representative Charlie Crist (via video)	U.S. Representative, Florida's 13 th Congressional District
Nicole Kinsman, Ph.D.	Alaska Regional Advisor, NGS, NOS, NOAA
Audra Luscher	Resilience Program Manager, CO-OPS, NOS, NOAA
Steven A. Murawski, Ph.D.	Director, Center for Ocean Mapping and Integrative Technologies, College of Marine Science, University of South Florida
Mark Osler	Senior Advisor for Coastal Inundation and Resilience, NOS, NOAA
Shachak Pe'eri, Ph.D.	Chief, Coast Survey Development Laboratory, OCS, NOS, NOAA
Daniel Roman, Ph.D.	Chief Geodesist, NGS, NOS, NOAA
Charles Seaton	Program Coordinator, Coastal Margin Observation and Prediction, Columbia River Inter-Tribal Fish Commission
Greg Seroka, Ph.D.	Physical Scientist, Coastal Marine Modeling Branch, Coast Survey Development Lab, OCS, NOS, NOAA
Hilary Stockdon, Ph.D.	Coastal Change Hazards Coordinator, U.S. Geological Survey
Peter Stone	Technical Director, CO-OPS, NOS, NOAA
Katrina Wyllie	Operations Lead, National Bathymetric Source, Operations Branch, Hydrographic Survey Division, OCS, NOS, NOAA

ATTENDEES:

Brent Ache	Ashley Chappell	Jacob Garcia
Edward Albada	Derek Chow	Patricia Gaynor
Corey Allen	Mary Cialone	John Gerhard
Kurt Allen	Melanie Colantuno	Heather Gilbert
Mark Amend	George Cole	Sherryl Gilbert
Jeffrey Andrews	Brian Connon	Matthew Gipson
Mike Aslaksen	John Conyon	Thomas Glennon
John Atkinson	Jose Cordero	Catherine Goggins
Patrick Barrineau	Jason Creech	Christine Golden
Megan Bartlett	Robin Czerwinski	Kyle Goodrich
Richard Bernard	Karen Dacres	Alastair Graham
Travis Black	Donald Darling	Sarah Grasty
Lucila Bloemendaal	Jon Dasler	Denis Hains
Rachel Bobich	Lauren Decker	Bill Hanson
Michael Bogonko	Freedom Dennis	Cheryl Hapke
Glenn Boledovich	Daniel Determan	Simon Hardern
Adrian Borsa	Geoff Dipre	Colby Harmon
Karen Bradbury	Chris DiVeglio	Scott Harris
Steve Brodet	Rob Downs	Olivia Hauser
Helen Brohl	Angel DuBose	Warren Hausman
Scott Brotemarkle	Claire Enterline	Chrissy Hayes
Mark Bushnell	Rod Evans	Lisa Hendriksen
Desiree Butler-James	Colleen Fanelli	Jack Herbert
Dana Caccamise	Jeffrey Ferguson	Michael Hernandez
Hannah Cacner	Katherine Fitzenreiter	Lucy Hick
Tom Campbell	Chris Freeman	Anna Hilting
Edward Carlson	Sloan Freeman	Anand Hiroji
J. Anthony Cavell	Rose Ganley	Sue Hoegberg
Katherine Chambers	Daniel Garatea	Patrick Hogan

Amanda Holt	Marta Kumle	Scott McMullen
Kim Holtz	Kristen Kusek	Mark Merrifield
Matt Hommeyer	Edward Kuwalek	Alicia Metzger
Tricia Hooper	Jorge Lagos	Steven Meyers
Nathan Hopper	Brendan Lally	Rennie Meyers
Liesl Hotaling	Jay Law	Michael Michalski
Stephan Howden	Jason Ledet	David Millar
Erika Hughston	Chad Lembke	Annick Miller
Denise Hunsucker	Alan Leonardi	Jon Miller
Karen Hyun	Irv Leveson	Joyce Miller
Ed Ide	Lou Licate	Crescent Moegling
Melissa Iwamoto	Devon Liles	Bob Moshiri
Arye Janoff	Carolyn Lindley	Dean Moyles
Michael Jarvis	Eva Lipiec	Ed Myers
Kevin Jerram	Yonggang Liu	David Naar
Rachel Johnson	Nathan Littlejohn	Guy Noll
Paul Johnson	Carol Lockhart	Summer Ohlendorf
Caitlin Johnson	John Lowell	Harold Orlinsky
Christos Kastrisios	Mark Luther	Hadley Owen
Brad Kearse	Chris Malzone	Jeff Oyler
Analise Keeney	Damian Manda	Laura Pagano
John Kelley	Elizabeth Marshall	Jyothirmayi Palaparthi
Janelle Kellman	Elizabeth Marshall	Hillary Palmer
Kitch Kennedy	Evan Martzial	Chris Paternostro
John Kidd	Giuseppe Masetti	Brandon Paterson
Carolyn Kieft	Alexis Maxwell	Meredith Payne
Tim Killeen	Bob McConnaughey	Scott Perkins
Brad King	Gabby McGann	Leigha Peterson
Katie Kirk	Meghan McGovern	Joel Pfeiffer

Nguyet Phan	Matthew Smith	Jennifer Walden
Ann Phillips	Steve Soherr	Collin Walker
J. J. Plunkett	Julie Steinberg	Gerard Walter
Julia Powell	Heidi Stiller	Ron Walz
Robert Ramsdell	Lucas Stotts	Larry Ward
Laura Rear McLaughlin	Quentin Stubbs	Kyle Ward
Glen Rice	Weifeng Sun	Nathan Wardwell
Quin Robertson	John Swartout	Ryan Wartick
Lorraine Robidoux	Aaron Sweeney	Louis Wattigney
Starla Robinson	Emma Taccardi	Irene Watts
Colleen Roche	Caleb Taylor	Tom Weber
Jackie Roller	Brian Tetreault	Robert Weisberg
Mark Safran	Julianna Thomas	Mike Wernau
Al Sandrik	Phillip Todd	Meredith Westington
John Schneider	Robin Trinko Russell	Marian Westley
Paul Scholz	Gillian Trommer	Jeremy Wetzel
Rick Schwabacher	Grant Twilley	Dave White
Cynthia Sellinger	Harper Umfress	Douglas Wood
Nancy Seroka	E. J. Van Den Ameele	Darren Wright
Andrew Shamaskin	Chris van Westendorp	Daniel Wright
Steven Simon	Don Ventura	Wei Wu
Gabrielle Sinnott	Eric Vichich	Jiangtao Xu
Alison Sleath Grzegorzewski	Branden Villalona	Taylor Zimmerman
Joshua Small	Jorge Viso	