

U.S. IOOS Advisory Committee
Hybrid Public Meeting
Meeting Minutes
June 27-29, 2023

IOOS Advisory Committee Members Present:

Scott Rayder, Leidos (Chair)
Sara Graves, Ph.D., University of Alabama in Huntsville (Co-Chair)
Jason Biggs, Ph.D., Guam Department of Agriculture
Daniel Costa, Ph.D., Institute of Marine Sciences, University of California Santa Cruz
Catherine Edwards, Ph.D., Skidaway Institute of Oceanography, University of Georgia
Eoin Howlett, Trinnex
Molly McCammon, Alaska Ocean Observing System (AOOS)
Julio Morell, Caribbean Coastal Ocean Observing System (CARICOOS)
Ruth Perry, Ph.D., Shell Renewables & Energy Solutions
Daniel Rudnick, Ph.D., Scripps Institution of Oceanography, University of California San Diego
Oscar Schofield, Ph.D., Rutgers University Center for Ocean Observing Leadership
Jyotika Virmani, Ph.D., Schmidt Ocean Institute
Richard “Dick” West, ADM (ret.), Independent Consultant
Robert “Bob” Winokur, Independent Consultant
Carrie Schmaus, DOE (ex officio)
Kristin Yarincik, IOOS Association (ex officio)

IOOS Staff in Attendance:

Carl Gouldman, Director, IOOS Office
Krisa Arzayus (DFO), IOOS Office
Courtney Edwards, IOOS Office
Laura Gewain, IOOS Office
Maria Murray, IOOS Office
Brandon Barlow, IOOS Office
Matt Hodanbosi, IOOS Office

DAY 1 - June 27, 2023

Meeting Welcome and Administrative Updates

Krisa Arzayus, U.S. IOOS Advisory Committee Designated Federal Officer and Deputy Director, NOAA’s U.S. IOOS Office

K. Arzayus welcomed everyone to the June 27 U.S. Integrated Ocean Observing System (IOOS) Advisory Committee public meeting which was chaired by Scott Rayder, Chair, U.S. IOOS Advisory Committee. She stated that NOAA appreciates the time and diligent work of the Committee in preparing for this meeting and for their forthcoming deliberations. K. Arzayus provided an overview of her role as the Designated Federal Official (DFO). She noted that the objectives of this meeting are to progress on phase 2 of the Committee work plan. Copies of the reading materials and notes are available on the committee website. The meeting will be recorded for internal use only, and will not be available to the public. Meeting minutes will be prepared by the staff.

S. Rayder welcomed everyone, with a special welcome to Rachel Dempsey, the new Deputy Assistant Administrator in NOS. S. Rayder and K. Arzayus thanked the Monterey Bay Aquarium Research Institute (MBARI) for their willingness to host the meeting. R. Dempsey was then introduced and given the floor to share her experience in NOAA as of yet.

U.S. IOOS Office Update

Rachael Dempsey, Deputy Assistant Administrator for Navigation, Observations, and Positioning (DAA-NOP)

R. Dempsey shared her career experience and connections to IOOS, which included the use of IOOS data for research. She appreciates the ability for her to use her experience in oceanography for public service. The strong culture of teamwork within NOAA was also noted. R. Dempsey looked forward to hearing opinions from the advisory committee about important NOAA topics, including coastal resiliency, equity, the growth of the new blue economy, and equitable access to healthy coastal and marine ecosystems. The floor was then given to C. Gouldman for U.S. IOOS office updates.

Carl Gouldman, Director, U.S. IOOS Office

C. Gouldman began his presentation on the IOOS national office updates. C. Gouldman noted the three NOAA strategic goals are to build a climate ready nation, make equity central to NOAA's mission, and accelerate growth in an information-based economy. The fiscal year (FY) 24 budget was explained on a regional, national, and portfolio/program level. Additional information about the Inflation Reduction Act (IRA) budget was also shared. The committee was reminded that the recommendations provided by them were focused on climate impacts, the growth of the new blue economy, and diversity, equity, inclusion, and accessibility. Additional information was given regarding the NOAA responses to the recommendations. Rather than ask for more recommendations moving forward, C. Gouldman would like the Committee to dig deeper into implementing the NOAA response around IRA projects.

Additional information regarding the new blue economy and the climate accelerators Notice of Funding Opportunity (NOFO) was provided. S. Rayder asked if obligations to the regions can be rescinded. C. Gouldman responded that it is possible, but very difficult and unheard of. S. Graves asked for clarification regarding the upcoming non-permanent positions. It was asked if the number of positions announced will be determined by IRA funding, and if that number could change. C. Gouldman confirmed and recognized that the number is susceptible to change based on the national office's level of risk tolerance. K. Arzayus noted they changed some federal positions to contract positions to help alleviate some risk. S. Rayder commented that NOAA cannot create a 5-year funding plan, but perhaps that could be a recommendation that should be made to NOAA. R. Perry asked what the term "technical assistance" means in the context of the presentation. C. Gouldman replied that technical assistance will support funds being sent elsewhere for grants support (but not internal grants support which is covered under management and administration), and data scientists and data managers. R. Perry followed up by asking where the data infrastructure piece falls within the plan. C. Gouldman responded that funding for data infrastructure is limited in this plan.

M. McMammon inquired about the level of competition for funds among the regions. C. Gouldman replied that the level of competition varies based on the topic area - for Topic Area 1, all regions will receive an equal share of \$55M and for Topic Area 2, the remaining \$45M will be

more flexible. S. Rayder asked how the IOOC could play a role. C. Gouldman responded that it was frustrating that the different entities couldn't work together in this process because things were changing too quickly. He has asked Dr. Spinrad for help in allowing this coordination and IOOS intends to have a 6-month application window to support coordination. S. Rayder noted that David Applegate, Director of U.S. Geological Survey (USGS), is frustrated that NOAA received more IRA funding and S. Rayder feels there could be a recommendation from the Committee about this.

D. Rudick expressed gratitude for this funding and towards the IOOS office for implementation of this work. R. Perry was discouraged about the RFA encouraging establishing new partnerships instead of utilizing existing partnerships, which may be unfair towards certain regions. There should also be space to allow using existing partnerships in new ways. C. Gouldman mentioned that the new partnerships focus on the equity and service delivery element and that it is included as a suggestion.

C. Gouldman further explained the Climate Resilience Accelerators (CRA) NOFOs. M. McCammon expressed concern about the limited timeline for certain communities (e.g., indigenous communities). C. Gouldman acknowledged this concern. Further information was also provided regarding the CRA proposed themes, partner projects, and timeline.

C. Gouldman discussed the workforce development collaboration between NOAA and National Science Foundation (NSF). S. Rayder asked how they will engage with the private sector. C. Gouldman discussed wanting to have a dialogue about what they can do together, providing examples of a jobs fair at conferences and having government/private sector internships. S. Rayder suggested using the Intergovernmental Personnel Act.

M. McCammon mentioned that the amount of information provided was overwhelming and asked how the FAC can help. C. Gouldman responded having conversations about getting this work done and planning over the next few years. McCammon further inquired what specifically C. Gouldman would like the committee to do. C. Gouldman requested that the committee discuss how to implement the repeatable engagement process (slide 22 of the presentation) across multiple timeframes (e.g., the next 6 months, 12 months, 48 months, etc.) on the subjects listed on slide 20. S. Rayder commended IOOS for their plan to obligate the funding to the regions and then stretch it over 5 years.

J. Biggs was concerned about how inundated the western Pacific is with work. It isn't a capacity issue, but an issue with the condensed timelines. He also expressed concerns of recycling the same programs due to the fast timelines. J. Virmani asked why the timeline is so short, and M. McCammon mentioned that the upcoming election is a major driver. Responding to J. Biggs' concerns, C. Gouldman said that he tried to have the schedule changed, but was denied. J. Virmani suggested the Committee make a recommendation on this issue- if NOAA truly wants to focus on equity, different timelines are needed. S. Rayder said NOAA needs to return to having a program structure. R. Dempsey said there will need to be a tie-in with national security in order to justify an extended schedule. There was further discussion about the need for a list of unfunded requirements, which all the regions have in the Tier 2 list of projects.

Updates from IOOS Association

Kristen Yarincik, Executive Director, IOOS Association

K. Yarincik discussed the vision for the IOOS Association (IOOSA). The IOOS Association current initiatives include offshore wind (OSW), marine carbon dioxide removal (mCDR), and the National Harmful Algal Bloom Observation Network (NHABON). Additional funding numbers were provided regarding NHABON. K. Yarincik notified the committee of the National Oceanographic Partnership Program (NOPP) Ocean Life forum occurring on August 9-10. The IOOSA DEIA fellowship had recently concluded, and it is not a priority to fill the position at this time, particularly with the Partnerships and Service Delivery position coming in the IOOS Office. However, work from the fellowship will be expanded upon and utilized. IOOSA has been facilitating support for the Center for Blue Economy. K. Yarincik mentioned updates from the IOOS Spring meeting that the CARAID award was granted to Tara Owens from the Hawaii SeaGrant in March. The total IOOS regional request for funding was \$80.5 million, and additional justification for the number was provided. Distribution of signatures for the dear colleague letter was as expected. Looking forward into FY24, there is a risk of reduced appropriations given the Bipartisan Infrastructure Law (BIL) and IRA funding, but they will continue to emphasize the importance of the funding.

S. Rayder asked how IOOSA is preparing with the Hill on a long-term continuing resolution (CR). K. Yarincik responded that IOOSA is not currently working on a strategy, but is prepared for level funding if that happens. S. Rayder asked if it's possible for IOOS to make the case that their data is essential and therefore excluded from the CR, noting the previous discussion about national security. He also noted that the NWS is fully funded during a CR and if NWS is using IOOS data, that could allow for an exception.

R. Perry inquired about what the renewable portfolio looked like, broadening from the current offshore wind discussion. K. Yarincik mentioned that they are considering expanding the ecosystem monitor strategy to incorporate national forms of renewable energy along with offshore wind. O. Schofield mentioned that an argument for health and human safety at sea can be a strong justification for observing funding. B. Winokur asked how the new funding is directly related to the FAC recommendations (a chart, etc). C. Gouldman agreed this would be helpful. D. Rudnick noted that in his region, Tier 2 proposals are equal in funding to Tier 1, so spending the new funding wouldn't be an issue. H. Ruhl asked if the IOOS needs are included in the \$500 million. C. Gouldman said that IOOS needs are not included in the \$500 million. He added that he is concerned about the limited resources of the RAs to apply for all these funding opportunities, along with the reporting needed for IRA.

CeNCOOS Session

Chris Scholin, President and CEO, MBARI

C. Scholin provided an overview of the host institution, the Monterey Bay Aquarium Research Institute (MBARI). With inspiration drawn from the Challenger's first expedition and Woods Hole Oceanographic Institution's Alvin submersible, founder David Packard thought Remote Operated Vehicles (ROV) would offer a better way to explore the deep sea. He built MBARI at the head of the Monterey Canyon because the deep sea is right out the door. C. Scholin described the campus and its new expedition staging facility for new instrumentation integration and testing, which will be the base for CeNCOOS, robotics, and autonomous

underwater vehicles (AUVs). MBARI is also constructing a new 50m ship, the RV David Packard, built with a side launch (expected arrival at the end of the calendar year).

C. Scholin laid the vision for the MBARI ten-year Strategic Roadmap. Everything MBARI will do locally will be relevant globally. They will measure ocean change and combine technology and science to drive innovation. MBARI is looking to build scalable technologies, map the deep seafloor at high resolution, and advance AI. In collaboration with Kelly Goodwin at NOAA, MBARI has a long-range AUV with payloads for Environmental Sample Processor (ESP), bioluminescence, bioacoustics imaging, and water sampling. They've discovered >200 new species in their own backyard. MBARI researchers are looking at biological vertical migration and what that does to carbon flux. MBARI outreach, done in partnership with Monterey Bay Aquarium, aims to make ocean research accessible for all so that people understand we should be taking care of the ocean, regardless of where you live.

S. Rayder asked about the size of the total MBARI workforce. C. Scholin responded that there are about 200 employees and that MBARI has no organizational divisions among different disciplines.

Henry Ruhl, Director, CeNCOOS

H. Ruhl began with a land acknowledgement to the Hueñeren and Guacharron peoples, which today are represented by the Amah Mutsun Tribal Band. For more on the MBARI land acknowledgement, go to: <https://www.mbari.org/about/mission-values/dei-at-mbari/>. H. Ruhl then provided an overview of the Central and Northern California Ocean Observing System (CeNCOOS). CeNCOOS is looking to provide information solutions that benefit a sustainable blue economy. CeNCOOS engages stakeholders to understand needs, collect relevant data and observations, and create data products based on those needs. They work to figure out the list of users, and some of the newest groups are related to offshore wind. H. Ruhl reviewed CeNCOOS program office staff and principal investigators. The CeNCOOS team, their board, key stakeholders, and collaborators recently met to plan CeNCOOS' role in climate and coastal resilience and what projects will fit within new funding opportunities. The region has recently had some intense storms, causing damage locally in Santa Cruz County. Harmful algal blooms (HABs) have also been in the news, with a current bloom at the southern end of their range that is affecting hundreds of marine mammals. CeNCOOS data are feeding into models that help predict and track HABs and provide warnings.

H. Ruhl outlined CeNCOOS core activities: 15+ shore stations, 3 glider lines, more biology (eDNA, animal tagging), regional climate index, and 31 high frequency radar (HFR) systems and their recapitalization, satellite products for kelp, and a regional climate index for California. They are trialing river sondes to provide higher resolution so they can try to constrain discharge of microplastics and chemicals. CeNCOOS is looking at impacts of aquaculture, HABs, ocean acidification, hypoxia, and the coastal climate signal. They also provide modeling, including atmospheric, biogeochemical, the West Coast Operational Forecast System (WCOFS), and building high-resolution nests within WCOFS to include areas for OSW development. The CeNCOOS data portal, which is shared with the Southern California Coastal Ocean Observing System (SCCOOS) has now 1800 data lines and there are plans for improvements to improve features and serve customers better. CeNCOOS is working to support a clear need and impact for biology and ecosystem data, where the state has a lot of interest. Biological data are more

complicated to collect and manage than physical and chemical data. CeNCOOS uses eDNA and drone observations, among other measurements, to look at biology from jellyfish to marine mammals. CeNCOOS has a Deep Ocean Observing Strategy through NSF AccelNet Program to bring deep ocean to the Global Ocean Observing System (GOOS) because the West Coast Exclusive Economic Zone (EEZ) is almost entirely deep sea and is included in OSW development plans. CeNCOOS does lots of engagement including congressional engagement to tell Congress how good IOOS is. CeNCOOS is thinking about how to use technology in innovative ways that deliver on requirements through its Synchro project. H. Ruhl enumerated several priorities for CeNCOOS across governance, observations, data management, models, and products.

Alex Harper, Program Manager, CeNCOOS

A. Harper provided an overview of the CeNCOOS-run California Current Acidification Network (C-CAN), which is part of a nation-wide network of Coastal Acidification Networks. The Northern and Central California regions care about ocean acidification (OA) and hypoxia because it affects many of the calcifying organisms in our region, including pteropods. They are seeing a clear decrease in pH, steeper than Mauna Loa and there is a hotspot near Cape Mendocino. The Dungeness crab industry is concerned, which is the most commercially valuable fishery in California. Many years ago, IOOS funded a project in response to a major mortality event in the shellfish and aquaculture industries. CeNCOOS has maintained these partnerships with these industries and they help advocate for IOOS. The C-CAN was established after this mortality event. In the mCDR arena, CeNCOOS is engaging with the commercial fishing industry through a NOPP-funded project. A. Harper addressed the state interests and activities in OA and hypoxia monitoring, areas where the state has action plans. CeNCOOS makes strategic investments in OA and hypoxia to improve data quality, consistency, and density. CeNCOOS jointly supports data collection through shore stations, coastal moorings, Applied California Current Ecosystem Studies (ACCESS) surveys with the local National Marine Sanctuaries, and biogeochemical (BGC) sensors on gliders. CeNCOOS is collaborating with other long-term observation programs in a way that state managers can use and understand to improve management of sensitive species and ecosystems. CeNCOOS is developing a mini-portal for hypoxia and OA within the CalOOS portal for state managers as a toolkit to deliver the information in ways the users want to see it.

D. West asked what appropriations language comes with the HAB money. K. Arzayus and C. Gouldman responded that it is not terribly prescriptive. It includes language about maintaining the pilot projects we have and establishing a national team of algal bloom observing networks in coordination with the National Centers for Coastal Ocean Science. H. Ruhl says CeNCOOS is using National HAB funding for a network of Imaging Flow Cytobots to deliver real-time information on plankton, including HABs.

Mark Carr, Professor, UCSC

M. Carr's talk focused on Marine Protected Areas (MPAs) and the growing interest in MPAs. There is an international 30x30 initiative to protect 30% of coastal waters by 2030. MPAs can protect entire ecosystems, not just species. MPAs vary in their extent of protection (e.g., partial-take protects some species vs no-take protects all species), what they protect, and their spatial design (e.g., networks of MPAs vs single large MPA). California has two kinds of MPAs: National Marine Sanctuaries (four, NMS) and state MPAs (124, varying in protection levels). The goals of NMS are to safeguard areas with special ecological, cultural, and historical significance. Performance evaluation against these goals is done through condition reports and climate

vulnerability assessments. IOOS is crucial to both of these and can help with more up-to-date dissemination as well as by providing data. The goals of state MPAs are to protect natural diversity and ecosystem functions; improve recreational, educational, and study opportunities; sustain populations and habitats; clear objectives and management; and management as a network. Performance evaluation has two ecological assessments to evaluate and attribute ecological conditions to the establishment of the MPA and to evaluate network performance. The hypothesis is that biomass should increase over time through more individuals of greater size in comparison to unprotected areas or unprotected species. Network performance evaluation looks at the larval population connectivity.

M. Carr then discussed the IOOS-related data needs for MPA evaluation. Evaluation can be affected by climatic perturbations, like the largest marine heatwave in 2014-2016. This requires near real-time and forecasted information about environmental conditions. The modeling needs to be ground-truthed through empirical data. The CalOOS data portal has the California MPA dashboard, which includes larval dispersal models. Assessments require technology to facilitate real-time and forecast modeling and ground-truthing with web-based information accessibility.

M. McCammon asked how the dashboard interfaces with the West Coast Alliance report card. H. Ruhl said that is a work in progress. The California scorecard is in development and isn't linked at this time. They are looking to transition the toolkit to Sanctuaries and the OSW industry. M. McCammon said this topic will come up in the NOAA Science Advisory Board this fall. H. Ruhl said the backend will be common, but you can set up storefronts to target different customers. CeNCOOS has users that ask for very specific data delivery, which explains why there are so many different dashboards.

Kakani Katija, Principal Engineer, MBARI

K. Katija overviewed the Ocean Vision AI (OVAI) project, which endeavors to accelerate marine life (ML) observations using artificial intelligence (AI). The NSF Accelerators program funds the project, which is halfway through. The funding expires in September 2024. There are many strategic partnerships, including NOAA. K. Katija stated video is the best way to make observations of ML. In a video from a vehicle in Monterey Bay, K. Katija showed how visually rich information needs to be converted into data: identifications, counts, metadata. OVAI is working to automate this process and the big data challenge through AI and broad community engagement. The bottleneck is human involvement for training data and human verification. The project focuses on how to build effective human-AI interfaces, working with both experts and enthusiasts. Each of these groups will require different platforms. FathomNet is a global and ML model repository for taxonomic aggregation and launched in June 2023. OVAI Portal is for people who have data and need help processing it and is being released in several beta versions starting this summer. FathomVerse is a video game phone-based app to engage ocean lovers and animal lovers in analyzing data. OVAI is inviting beta testers for the FathomVerse MVP this summer, and several committee members took interest in participating or making connections to potential beta testers. They are looking into sustainable funding models beyond the NSF funds.

S. Graves expressed interest in these advances based on her prior involvement in the satellite data versions. K. Katija said she's been inspired by iNaturalist and eBird, but there's a gap for ocean ML data. The question is how can we keep up the expertise inputs with the data

collection and technology innovation. S. Graves asks about ROV video, like the one shown. K. Katija responded that the source of the visual data doesn't matter and OVAI would help data holders develop models specific to their use case and borrow from established models. The three platforms are important for filling the gaps and addressing specific communities.

R. Perry asked if the numbers in the video are levels of confidence in the identification. K. Katija responded that they are, allowing more focused efforts on IDs with lower confidence. E. Howlett praised the project and asked where they are hosting the data and processing. K. Katija responded they are currently using AWS for all data hosting and some computing in the cloud. C. Gouldman asked what the timeline for the project is after the NSF funding ends. K. Katija responded they are evaluating several options and are using a non-profit model, possibly with MBARI serving as a financial host. They have put out a couple proposals to help sustain them past the NSF funds. They are also looking at subscription models both for access and use. C. Gouldman proposed helping to brainstorm and that there might be a funding model that parents would pay for their kids to play the game due to the educational value. K. Katija said they are looking at a mechanism for donation through the game. H. Ruhl said this is trying to be inclusive globally. Because it's non-governmental, they can be more inclusive. We're working with the Marine Biodiversity Observation Network (MBON) community to pull in their data. There's also the business planning and how IRA RFA and NOFO might play into this.

J. Virmani asked how much time it took to get feedback for FathomVerse. K. Katija said it took 1.5 years to get the community input. J. Virmani noted OVAI is game-changing and now endorsed by the UN Ocean Decade which will open up other possibilities for funding.

R. Perry noted the great interest in moving this concept up the water column. She has been working with Google Analytics looking at platform observations to process existing data. K. Katija said the idea is to be agnostic on platform, imaging-system, and region. R. Perry said she has fishermen who would participate. K. Katija pointed out the game is high school-age and up. J. Biggs concurred that crowdsourcing should be used to fix climate change issues. Pull people in to accelerate science, teaching them, making them feel something, and giving them hope by participating in solutions.

Amy West, Synchro Program Manager, MBARI

A. West presented on Synchro, a co-design lab and testbed to evolve technology into a solution. The program works to boost access to testing of emerging tech tools and accelerate their use in the ocean community, addressing the Valley of Death (Opportunity) where technology faces a rigorous testing process before going to market. Many technologies struggle to get through the Technology Readiness Level hurdle. The program engages information users and scientists at all stages and is a massive collaboration, including CeNCOOS governing council members and Monterey Bay area marine research organizations. The program is sponsored by the Moore Foundation, Oceanskind, and Schmidt Marine Technology Partners. The three pillars of evaluation are testing/evaluation, low-cost tech procurement with a focus on ecology and biology, and case study for monitoring OSW effects. Whatever is developed will be scalable. The challenge is the monitoring requirements aren't there yet for OSW, so they're looking to the progress made for MPAs. The project has a very compressed schedule in the beginning and concludes at the end of 2026.

S. Rayder pointed out NOAA has been very interested in observing systems assimilation experiments. He could see a systems analysis of IOOS, Global Ocean Monitoring and Observing (GOMO), and National Data Buoy Center (NDBC) integration. H. Ruhl said there is a model framework to look at upwelling observations and modeling to bridge that to OSW. J. Virmani clarifies this will be a place you can test technology that can feed into observing systems rather than systems. S. Rayder brought up data buys noting you have to demonstrate the data being brought in will bring in skill. He sees this as a possibility. He also thinks NOAA struggles with R2O.

R. Perry said linking technology, skilling, and data makes sense. The case study on effects will always lose if there isn't a regulatory application. That's the verification gap that has to be closed. There will be a divide between the industry and what the regulators need. This is a problem we're seeing on the East Coast to understand if the right risk tradeoffs are being made because the regulators can't move away from what they know in human observations to technology-based observations. J. Virmani believed the codesign aspect will address this. R. Perry said the managers were in the room last week, but the regulators were not. That's been the huge impasse—it's missing the regulators. You need National Marine Fisheries Service (NMFS), Bureau of Ocean Energy Management (BOEM), and state regulators. The biggest strength you have is showing and validating the technology, but it's important not to get away from what the regulators need. H. Ruhl welcomed further conversation on this because it's still a challenging discussion and noted they have some state fish regulators. S. Rayder noted the potential to move best available science to regulators. However, D. Costa agreed that R. Perry was right on target. Scientists have come up with great paradigms in ocean sound, but NMFS doesn't know how to use it. They have started conversations with NMFS to bridge the gap. R. Perry suggested putting the regulators on the boats to see the technology because they aren't involved in current science. It's not just NMFS; it's also state and other regulators. This may be an opportunity for IOOS, given the stakeholder engagement strengths to find a way to translate to regulators. IOOS can be an integrator at the national level. S. Rayder said the data are the data, and IOOS is the honest broker of the data. R. Perry said this means there needs to be an all-agency adoption of being the honest broker for the data. There has to be interpretation of what best available science is to include data and technology. M. McCammon asked if there is a role here for the IOOC. S. Rayder said any rule that comes out has to go through the Office of Information and Regulatory Affairs for review. Regulatory schemes sometimes are not flexible enough to handle innovation and when "best available science" changes.

S. Rayder suggested Google Ocean would be very interested in this because they're taking in a lot of ocean data. H. Ruhl said Synchro is taking advantage of all the technology in the area and has Schmidt Marine Technology Partners as a sponsor. R. Perry saw the potential for Synchro 2.0 to be acoustics because we need to know where every right whale is vocalizing. She is having to put in \$10M a year for mitigation for acoustics, which can go through the IOOS regions to serve as the honest broker.

Conversations with Local Officials

Representative Jimmy Panetta, U.S. Congress (CA-19)

S. Rayder brought up that at the previous IOOS AC meeting, the group discussed the importance of involving more local officials. Representative Panetta was not able to join the meeting in person, but gave a video presentation. In the video, he welcomed the IOOS AC to his district

along the Central coast of California. Rep. Panetta mentioned the importance of protecting the ocean for our economy and the environment. Rep. Panetta said that it is vital to maintain and strengthen the regulations that protect the ocean, which is done with the help of those on the AC. Rep. Panetta brought up the Inflation Reduction Act, stating that it is a historic investment in tackling climate change and the largest investment in human history to reduce anthropogenic carbon output. The Inflation Reduction Act includes a 2.6 billion dollar investment in climate resiliency, which will support job creation and economic progress. The Inflation Reduction Act increased the construction budget of marine sanctuaries from \$4 million to \$50 million and includes \$7 million for a new NOAA office on the California State University, Monterey Bay, Campus. Rep. Panetta is committed to continue working to protect our oceans.

Senator John Laird, California State Senate

In a video presentation, Senator Laird started by welcoming the IOOS AC meeting to his district and wishing that he was able to join the meeting in person. He stated that he was the head of the Ocean Protection Council for 8 years and lived on the coast for 50 years, so he has a strong commitment to ocean issues. Sen. Laird then mentioned a number of issues that coastal areas in the district are facing, including breached sea walls, exposed sewer pipes, and highways closing due to erosion. The State of California Senate's proposed budget includes billions of dollars for climate issues, including major investments in coastal resiliency. Senator Laird has proposed a Senate bill, (Bill 272), which will be the next step in state planning for sea level rise. He mentioned the importance of having discussions regarding climate change before extreme events occur, and that the State of California is attempting to do that in partnership with local and regional governments. The senator is excited to hear the results of the meeting and hopes to be able to join next time the AC is in the area.

Laura Suddes, Policy Advisor/District Representative, Office of California State Senator John Laird

S. Rayder introduced L. Suddes and asked her to give a brief introduction including her work for the senator. L. Suddes started working for Sen. Laird earlier in the year. Due to the staffing organization in the office, she works on a variety of topics in Santa Cruz County, but has a degree in oceanography. Therefore, she is excited to join the AC meeting and in the future intends to work on coastal, marine, and environmental issues more widely in Sen. Laird's office. One of the reasons that L. Suddes pursued a degree in oceanography is because she was concerned with the way in which science was being translated to lawmakers, so that she could be educated in science and then advise policy makers.

S. Rayder asked what we can do to better communicate the value of ocean observing with the public. L. Suddes replied that relating the importance of the ocean to the globe is essential. A lot of people might not know that the oceans produce 50% or more of the oxygen that we breathe. L. Suddes shared that she read a book called *Saving Us* by Dr. Katharine Hayhoe. The main point of the book was to find something to relate to people's experience when you're speaking to them. S. Rayder asked if the recent atmospheric river raised awareness of the need for ocean observation and if California funds ocean observing. D. Costa said the initial high frequency radar (HFR) infrastructure was constructed by the state via a bond issue 20-25 years ago. The state legislature gave the academic institutions around \$100M for climate resilience issues. University of California Santa Cruz created a center for coastal climate resilience and got \$20M from the state legislature. The state of California has really been on the forefront of these

issues. S. Rayder noted that a bond issue is a one-time investment, and asked if the state provides investments to maintain the radar infrastructure. D. Costa said that has been an issue. California paid the initial investment, then CeNCOOS came in to maintain the operations (but they were not approached by the state to do so). D. Costa said California does have the Ocean Protection Council, which is a state agency that is funded consistently and has funded marine protected area work.

S. Rayder asked if the committee is allowed to make recommendations on how to work the states. K. Arzayus said if the committee is advising NOAA on what to do, then yes. S. Rayder asked what would the committee recommend back to this region in terms of what is working. Going back to the bond issue, there has been an institutional inertia in California where CeNCOOS is paying the operations and maintenance (O&M) costs. D. Costa added that part of the issue is that when the radar was started by the state, there was not a clear goal for what it would accomplish. There is also a great relationship between the federal and state marine protected areas right now. D. Rudnick said the state of California has invested a great deal in ocean sciences over the years. The state started California Cooperative Oceanic Fisheries Investigations (CalCOFI), which was a very important and forward-thinking investment. But the main way the state continues to support ocean observing is through the universities and colleges, through the University of California and California State.

S. Rayder said long-term continuous observations are critical and asked what they are doing in other regions compared to California. H. Ruhl said most of the dollars that CeNCOOS gets from the state are through competitively won grants. One of those projects was infrastructure for the IFCB network. There's now 10 of them in California, so that was a real success. In terms of the HF Radar, about 5 years ago CeNCOOS was desperate for infrastructure funding and went to the Ocean Protection Council but did not get any traction. The discussions were great, but there was no funding in the end. Then the Inflation Reduction Act came and that started to help, but CeNCOOS is still in a position to potentially underdeliver or not take best advantage of dollars because CeNCOOS still needs to fix the older radar. CeNCOOS does not do direct engagement with the state government. S. Rayder said the Bipartisan Infrastructure Law and the Inflation Reduction Act are going to help with upgrading the infrastructure, but there is still the question of the maintenance and operation cost. D. Rudnick said this is a fair question. California has done extremely well compared to other states. Except for CalCOFI, which lasted many decades, he has not seen an example where the state will support operation long term in the same way that NOAA will. S. Rayder said his concern is that the federal government may not always be there, so he is trying to think about what that funding model regime looks like so we do not lose the observation link. D. Rudnick said he thinks university salaries are all that the state is supporting right now in the operations and maintenance realm. D. Costa said the Ocean Protection Council has received modest funding by federal standards, but has been continuous for at least the last decade. A lot of the inshore coastal work has been done by the Ocean Protection Council.

S. Rayder asked if the state has ever developed an ocean trust fund. L. Suddes said the state has an ocean protection institution called the Ocean Science Trust that is a small nonprofit that was designated by the legislature in the last 10 years. They carry out similar things to the Ocean Protection Council. They are more of an academic or informational body that will approach and educate state legislators but she doesn't know if they actually fund ocean-based projects. M.

McCammon added that there is also a federal Ocean Science Trust that was authorized by congress but it is not funded. D. Rudnick said many state agencies rely on data from the Regional Associations and some get funding from the state.

S. Rayder asked how much of the CeNCOOS budget is covered by the state. H. Ruhl stated it is about eighty percent federal. S. Rayder stated that NOAA struggles to do maintenance and operations on its own systems. D. Rudnick said the other part of this is state-funded salaries. If you look at the two California regional IOOS associations, you will see participation from academics who are in the universities. D. Rudnick's salary that is paid for by the state allows him to be at the meeting today and do work on behalf of IOOS without having to charge his salary. IOOS to a larger extent across the country depends on that kind of support.

J. Virmani asked if it would be helpful to have a return on investment of how much is actually going into supporting IOOS from a state perspective and a federal perspective. M. McCammon said she doesn't think IOOS has done this because IOOS does not want to get into the requirement for a state match. J. Virmani said that there is a hidden cost of the people. R. Dempsey said that none of these issues are unique to IOOS. NOAA offices are handed appropriations constantly that have no tail, along with every other federal government entity. It is a disconnect. There is an opportunity for the Committee to advocate for long term sustainment. With the Inflation Reduction Act and Bipartisan Infrastructure Law, there will be a lot of opportunities for that because in 2027, IOOS will reach a fiscal cliff. C. Gouldman said he is confused by S. Rayder's comments, because sometimes S. Rayder says that IOOS should own things so that it is recognized as a need, then the inevitability of IOOS needing funding is obvious. With the High Frequency Radar, IOOS has not gotten into written agreements with the states and he knows that donations are not equal between states, so IOOS uses the network of the IOOS regions. CeNCOOS and SCCOOS get the money from the US IOOS Office, they prioritize what they can maintain, and that network of investments that the state makes is then funded by the federal government. What can be maintained and what cutoffs have to be made is a choice year by year that the US IOOS Office deals with in regards to appropriations. The Imaging Flow CytoBot network is being proven as a new technology, the largest network in the world is on the West Coast, and IOOS is starting to demonstrate value there. It will be good if the Regional Associations can maintain that with the increases in funding the US IOOS office has been able to get them.

D. Costa has two comments. There is a state oil spill prevention response program which was created after Exxon Valdez, where there is a dollar tax on every barrel of oil imported into California. This tax has continuously paid, since the 1990s, for California Fish and Wildlife Facilities to look for sea otters or any other oiled animals in case there is an oil spill. That is a potential model for other states. The other point is that D. Costa was involved in the Census of Marine Life and his project, Tagging of Pacific Predators, was funded by the Moore Foundation and Packard Foundation. He believes that Synchro will be an example of this, where private foundations want to be a catalyst, where they come in and say, "show us how wonderful this technology is and if it is any good, the federal government will pick it up." S. Rayder asked K. Yarnick, who was involved with the Census of Marine Life, if that happened. K. Yarnick said yes, it was a 10-year investment and the idea was that the government would pick up where Census of Marine Life left off to continue that biodiversity baseline monitoring but it did not happen. C. Gouldman said IOOS has been doing some with the Marine Biodiversity Network. K. Yarnick

agreed that some things have been happening but not in the way people expected. C. Gouldman said that is correct, IOOS had a piecemeal answer with an ad hoc approach, but it is still something.

S. Rayder asked C. Gouldman if any IOOS Regional Association had completely refreshed all of its infrastructure. C. Gouldman said no, because IOOS gets way too much done with a dollar. With the Bipartisan Infrastructure Law funds, the RAs are prioritizing and refreshing the HF radar parts and some regions have more invested than others. S. Rayder said it will be interesting to know what a complete cycling of infrastructure would look like. R. Perry said it will vary a lot by region, because some regions own very little infrastructure. S. Graves said the leveraging will also be important. For GCOOS, there are 5 states in the Gulf of Mexico versus 1 state for the 2 regional associations in California, so there is a lot of potential to leverage from the state universities. C. Gouldman added that the workforce that IOOS is getting for free should not be overlooked, which is not completely free because there is an indirect rate for some regions. The catcher's mitt function that the regions are providing, as a place where counties and states can have their data pulled into the national system database of record that it is maintained and integrated, is hard to put your finger on and measure how much IOOS gets done and the size of the impact. D. Rudnick added, not just California but across the board, when you look at what IOOS has invested in and then what else is invested in those same projects, it is going to be hard to wrap around all of that information. IOOS's investors are a pretty impressive group, mainly because of the people who are doing the work. People in the regions have to go to more than one source to get the funds to keep things going. That's just the way IOOS works and it is not necessarily a bad thing.

S. Rayder asked L. Suddes on the best way for a constituent to advocate for state funding of ocean observing. L. Suddes said she is coming with a lot of recent experiences locally that makes that an easy ask for her office because of the atmospheric rivers that just came through and all the flooding and coastal erosion. But for more resistant offices, find a way to explain to that specific office how the ocean observing system will benefit their office specifically. It has to be a one-off approach with different offices depending on their priorities. So she cannot give a straightforward answer because there are a lot of factors at play, like political affiliation or past history in the district. It is important to have some contextual knowledge of what is going on locally and to be thoughtful about what would be the most appealing approach.

S. Rayder said California's ocean observing systems are doing a lot that's right, but asked what they can improve upon. H. Ruhl said the biology needs are underdelivering right now compared to the policy needs. The policy needs are ballooning with offshore wind and CeNCOOS isn't able to deliver the level of biological data that is needed right now. The second issue is how to get the public ready to receive the data. That is complicated but the coding and programming knowledge nowadays is so much better than it used to be. A lot of graduates can code now and can be trained up to get to the IOOS level of data delivery. That is one of CeNCOOS's weak spots. Even though it has a great portal, it is still not meeting the need fully. S. Rayder asked if that is from being underfunded or not having the right people to do it. H. Ruhl said it is a little bit of both. There is a little bit of staffing and the amount of money only allows maintaining the status quo. With IRA funding, CeNCOOS can make that next generation, but that is going to require cooperation with other regions to also coinvest.

M. McCammon mentioned that the most impactful environmental event on the West Coast was “The Blob” ocean temperature anomaly from 2014 to 2016 and that there is now an El Niño event. She asked if the West Coast is better prepared for these events now. She has not heard anyone on the West Coast talking about these events, but hears conversations in the Northeast US about “The Blob” happening again. H. Ruhl said that the operational forecast system that he mentioned earlier is only a 3-day forecast and that the next best forecast system is a much longer window. So there is not good delivery of a mid-range forecast right now, but there has been improved delivery of climate indicator data that are relevant for California. M. McCammon asked if that means everybody is prepared and as soon as something happens, they are ready to act. H. Ruhl said no, they are not ready to act on these data. D. Costa added that we can predict these events but our ability to respond to earlier predictions has not changed much.

S. Graves brought up the example of the Gulf of Mexico with the Sargassum. She said that it is not just horrible for beaches, but horrible for human health. C. Gouldman said that Sargassum is complicated to manage because it is considered fish habitat when it’s floating. R. Perry added that it is also designated as sea turtle habitat in the entire Gulf of Mexico.

D. Costa said that the fisheries managers are going to respond to the El Niño signal because they do adaptive management. M. McCammon asked if that means El Niño is on the public’s radar. D. Costa said that the coastal communities are much more aware of what an El Niño means. People are aware that El Niño means it might rain more in a certain place and that the waters are warmer. Central California is an area where the rain and water temperature trajectory might go either way, so local people pay attention to these predictions. There is a greater awareness of what is coming down the road, but whether communities are prepared for it is a completely different issue. M. McCammon added that that gets into service delivery.

S. Rayder said when he thinks of the El Niño–Southern Oscillation (ENSO), he actually thinks of California fisheries. When the El Niño forecast is made, the fishing grounds off California change. These tradeoffs are important to understand. El Niño is a wonderful case because people can actually speak it, it is part of public knowledge. He asked how many know about the North Atlantic Oscillation (NAO) or these other oscillations. D. Costa said El Niño is really obvious in that it pounds communities in many different ways, but NAO is different. S. Rayder said tying the ocean into these larger societal events helps. D. Rudnick shared that his neighbors who know what he does for a career always ask him, “is there an El Niño this year?” People in California know what El Niño is and they would like to know about it because they think, “maybe I have to fix my roof this year because there is likely to be more rain.” And in general, the ocean observation system in California is pretty well positioned to monitor ocean conditions. Compared to other places, California has pretty good data and pretty good models. The caveat is that, because of the way California gets piecemeal funding from multiple sources, the ocean observing system is always a few years away from having no funding. But they never get to that point and are able to keep the system going. In general, the system is in pretty good shape and D. Rudnick is optimistic about its future. If you ask what the state could do to help more, it could always increase capacity to observe more. If you did a thorough search, you would probably find holes in the observation system.

S. Rayder asked about lessons learned for other regions. D. Rudnick said that one of the reasons that California has the Scripps Institution of Oceanography is because of the original investment in California Cooperative Oceanic Fisheries Investigations (CalCOFI). CalCOFI was a state

investment of \$10-20M to start. That was about half of Scripps' budget and that investment helped to make Scripps successful. Investments like that are not there anymore. That was a major investment upfront that has paid off. California has a world class oceanographic institution because of the investment from the state with the collapse of the sardine fishery. He is not sure how to turn that into a lesson for another state, but believes it is an example showing that if you invest in something enough to keep it going that it will pay off.

D. Costa said that you need to tie the weather patterns and the climatology to the ocean. The weather in the Midwest is driven by what is happening in the oceans. So that is the question, how do you bring it home to people who are not living on the coast? To D. Costa, the weather systems are the strongest tie based on the fact that people are talking about El Niño and what it might mean, not just for California, but for the rest of the country. Same with the North Atlantic Oscillation (NAO) and the other weather systems that are driven by the ocean. The other part of this, which was mentioned in one of the earlier presentations, is outreach. The success of NASA funding was discussed, noting their strong outreach efforts such as with the James Webb telescope images.

J. Virmani said that this goes back to something that the committee has discussed before, which is all of those big budgets and that there is a lot of money out there. NASA has a targeted, single easy-to-grasp vision. IOOS is fantastic, but it has many different goals and missions to accomplish. NOAA has 3 strategic priorities that are still fairly broad, as compared to a lunar vehicle for NASA for example. So the community needs to figure out that one thing and try to push on the outreach. The XPRIZE model is similar to NASA as well.

S. Rayder said that the community needs to think about working with policy makers like L. Suddes, J. Laird, and J. Panetta because there is not enough funding in the ocean community. The ocean community thought that ocean observing was going to be the hook for everybody, because if you have an observing system you're going to need ships, researchers, a database, etc. S. Rayder mentioned the Weather Research Act and said Congress is telling NOAA to refurbish the radar network. The initial cost of that refurbishment is over \$3 billion. His concern is that, if the National Weather Service gets \$3 billion in an authorization, that money will come out of the "wet side" of NOAA.

S. Rayder asked if L. Suddes had anything else to add. L. Suddes said that she was happy to join the meeting and that she is happy to talk more on this topic. She is happy to connect committee members to others for questions she couldn't answer. J. Virmani asked L. Suddes, in her work week, how often ocean issues are mentioned. L. Suddes said not as much as she would like. J. Laird's district encompasses the entire Monterey Bay and L. Suddes works in the Santa Cruz office and she sees ocean issues every once in a while.

Monterey Bay Aquarium and IOOS Collaborations

Margaret Spring, Chief Conservation and Science Officer, Monterey Bay Aquarium

S. Rayder introduced Margaret Spring, who joined virtually to provide a presentation on the Monterey Bay Aquarium, their engagement with CeNCOOS, and opportunities for collaboration on conservation issues.

The Aquarium has over 2 million visitors a year plus many millions of online connections. There has been an increase in online connections since the aquarium was closed for almost a year and they had to figure out other ways of reaching people. The aquarium spends a lot of time trying to reach people where they are and connect them to the wonders of the ocean. The aquarium collaborates with a number of organizations, such as Monterey Bay National Marine Sanctuary. The role of M. Spring's team of about 40 people is to take all of that connection and inspiration from the ocean and turn it into some action opportunities and engagement opportunities with decision makers and also bring that information to people so they understand the complexities of what is happening in the ocean. The Aquarium has a water intake from Monterey Bay, so one of the things they operate is a sensor node for CeNCOOS. They constantly measure physical parameters of the water entering the aquarium and share that as part of the observation system. M. Spring would like to promote that collaboration to the public to show them how ocean observations connect to their lives.

M. Spring then discussed some of the Aquarium's conservation priorities. Their most global work has been on global fisheries and aquaculture. The Aquarium works on assessing all the seafood that's imported to the United States by analyzing federal and state data. The space that the Aquarium uses ocean observing systems the most is protecting California's ocean wildlife and ecosystems, for example in supporting the creation of the sanctuary and the creation of MPAs. Another place that the Aquarium contributes to the system is through providing white shark movement data to the Animal Telemetry Network. The Aquarium would like to collaborate with IOOS more to assist with reintroduction efforts for southern sea otters along the West Coast. The Aquarium is also interested in the marine debris and microplastics issue. The most challenging barrier right now is low-cost sensors to monitor these kinds of pollution and the Aquarium would like to collaborate on this topic in the future.

S. Rayder asked M. Spring, what the biggest challenge is related to plastic pollution. M. Spring said that the problem is that this is an issue that is rapidly changing in scope. It has morphed in people's understanding from a waste issue to an environment issue to a human health issue and chemicals issue. There is a lot of money for advocacy, but not enough money in developing the science side. There is no science strategy to deal with this issue.

DAY 2 - June 28, 2023

NOPP Industry Panel

Danny Merritt, Lead Mechanical Engineer, Liquid Robotics

Katherine Zaba, Director of Glider Programs, MRV Systems

Matt Womble, Sr. Dir. of Govt. Relations for Ocean Data, Saildrone

Jochen Klinke, Science Director, Sea-Bird

Clara Hulburt, APEX Product Line Manager and Slocum Glider Commercial Sales Manager, Teledyne

K. Arzayus called the meeting to order and introduced the moderator of this first panel - R. Perry. R. Perry began the session by describing the National Ocean Partnership Program (NOPP) and mentioned that it is an important program for developing new technology for use by NOAA, but that public-private NOPP are underutilized within the federal government. The goal of the

panel is to provide information about the public-private partnerships that IOOS participates in and discuss the ways in which IOOS can better utilize NOPP moving forward. The panelists introduced themselves and described their public-private partnership involvement with IOOS in particular and NOAA in general.

The first question was the following: From your company and individual perspective, what new, innovative opportunities do you see for working with NOAA or other federal agencies in the ocean observing realm? C. Hulburt expressed the feeling for the relationship with IOOS and NOAA to be more like a partnership. She expressed that they don't know what the larger picture is, and if they had more information, it would make a huge difference. It would be helpful if NOAA could share a 5 year plan with them. D. Merritt echoed the sentiment. He also mentioned that a big part of the issue for them is the lack of conversations regarding NOAA's plans. Such conversations would allow his company to put internal dollars towards coming up with solutions. M. Womble added that having clear requirements to industry as to what it is that NOAA's looking to do would be beneficial. Clear requirements could then be used to build systems that can meet those requirements. There needs to be some level of predictability for the companies to know what they are building will continue to be needed. He also noted the IRA and BIL funding opportunities and questioned how NOAA plans to incorporate industry. K. Zaba mentioned that NOPP has been fundamental for them in running money for R&D and for the non-trivial effort of transitioning technology from an institution to a private company. She added it would be helpful to have support for partnering customers with their existing technology, not just for R&D for new technology. J. Klinke resonated with the previous comments. Having more opportunity to learn market size and specific needs was mentioned as a faster development driver. He added there could be an opportunity for the public sector to serve as a catalyst for bringing "platforming mindsets" to the table, rather than having individual solutions.

C. Gouldman asked for clarification on the comment regarding platforming. J. Klinke responded that reducing the specificity of the developed technologies would open the market and further justify market investment. D. Rudnick commented that another challenge is scaling the industry - how to decide which platforms should be scaled (because not all should) and making industry aware so they can build capacity. D. Costa provided an example with animal tags, adding that chasing a small niche by changing design could limit company growth. J. Klinke agreed. M. Womble mentioned that this issue is present in the vehicle manufacturing industry. They are integrating sensors from other companies onto their vehicles, and therefore have to ensure the data accuracy of those sensors. NOPP has helped with this, but it takes time and investment from industry. Once complete, it is difficult to see the operational pathway. D. Merritt mentioned that there doesn't seem to be a standardized pathway from NOAA - do they want the platform to operate themselves, or do they want the private company to run the mission as a service. J. Klinke mentioned that looking forward in terms of developing product roadmaps that have reusable modular designs is really needed. C. Hulburt mentioned that NOAA needs to have agreed upon requirements so industry can build to those (i.e what data output, what sensors, what platform should achieve, etc.).

J. Virmani wished to revisit the scalability conversation. She asked what challenges the panelists would have in meeting a hypothetical demand increase. K. Zaba said their best customers are ARGO and NavO because they have clear requirements and it makes it easy to scale. Where it

gets more difficult is when customers want unique modifications to existing products. J. Virmani asked if there was a way to put the specificity back on the customer in order to scale up, providing the example of apps vs. an iPhone, where an app can modify an existing product (iPhone). J. Klinke said that's something they are internally thinking about. D. Merritt expressed cautious interest in the idea. They have done this before, where a customer puts their own sensors on a SeaBird product, but it isn't as simple as that as there are always questions back to SeaBird. He also suggested utilizing "centers of excellence" within NOAA, where a capacity of experts are built that know how to do the work. C. Hulbert said they have experienced similar situations. However she has noticed groups of engineers and academia working on those one-offs together, which is how it should be. She added that the reason this structure works with an iPhone is that Apple developed industry standards, which are missing here for NOAA. M. McCammon mentioned that IOOS has a 5-year plan (but not funding for 5 years) and that NOAA is not allowed to create a 5-year funding plan, which impacts scalability. D. Rudnick added that not much can be done in its current state. He said they need to get the idea across that a distributed system like IOOS is just as worthwhile to invest in as a single system like a satellite. S. Rayder said NESDIS is headed towards more of a distributed system. He also suggests this committee make a recommendation around the need for a 5-year plan - there needs to be a way to bring budget certainty into the process. M. Womble noted that 5-year budget planning is possible because satellites do it and it is codified in law and approved by OMB. Every year the number in the life cycle cost is what ends up in the NOAA budget. This is why the private sector can build satellites with certainty for NOAA. He doesn't think there is a reason why IOOS can't do the same thing for ocean observing. The NOAA ship recapitalization program is also able to multi-year planning.

J. Biggs asked the panelists if they ever feel like the NOAA is compartmentalizing industry in a way that feels competitive, highlighting the benefits of working with trusted partners. J. Klinke mentioned that Sea-Bird's partnerships on the NOPP side is contrary to its partnerships within the ocean science community. K. Zaba said if there are well-defined requirements and framework, it allows all the companies to have a fair shot at developing for those requirements and prevents one company from being stood up.

O. Schofield circled back to the NOPP part of the conversation. He said much of IOOS grew out of early NOPP proposals to provide the foundation for regional associations. The RAs have their benefits in terms of regional priorities, but as the national backbone, there are aspects of IOOS that should be standardized across the system. This might provide a scale large enough for the private companies to become active partners beyond a NOPP program.

E. Howlett asked M. Womble what percent of their revenue is split between selling data versus selling hardware. M. Womble said that the company is 100% data service. K. Zaba, C. Hulbert, and J. Klinke stated they're 100% hardware. D. Merritt stated his company is more on the hardware side, but didn't know the numbers.

C. Gouldman expressed his thanks in being able to listen to the panelists' perspectives. He noted that IOOS could look at the infrastructure needs list from the RAs, looking at the next 3 years of funding under BIL, and attempt to count the number of platforms anticipated to be purchased. For IRA funding, \$40M of the \$100M from the Accelerators are going to existing programs. With the \$40M, \$8.9M is going to NOPP proposals on Marine life and \$15M is going

to NOPP proposals on marine carbon dioxide removal. He added that Topic 2 of the IRA RFA coming out soon will address O. Schofield's earlier comment about national-level projects.

R. Perry asked the panelists if they see any opportunities to innovate, change, or re-envision NOPP. D. Merritt asked how much federal representation was present in the conversations. He proposed that further representation beyond NOAA would be beneficial. S. Rayder mentioned that some representation exists in the conversation, but not all. He also mentioned that there's no nexus that brings the ocean community together, unlike NASA for space. M. McCammon expanded, saying that this kind of collective doesn't even exist in NOAA.

R. Perry provided an opportunity for the panelists to provide any reflections during the last 10 minutes. M. Womble wondered if NOPP is really the vehicle that you see enabling scalability of the ocean enterprise. He doesn't think it is because otherwise you would see an increase in the NOPP budget from industry lobbying. R. Perry added that one of the barriers to NOPP is the bias of working with technology industry versus regulated industry. J. Klinke asked the other panelists if they had been involved in sensor development for oceanographic applications directly. A few were noted. J. Klinke noted that NOPP has been really invaluable for them as an industry in having access to infrastructure that allows them field validation. M. Womble agreed. Scope of most NOPP proposals is huge. With the way their NOPPs are structured, the work for industry is weighted at the tail end of the cycle, so any deviations earlier in the cycle (schedule, budget, etc) is felt more heavily by industry. She compared this to a program like Small Business Innovation Research (SBIR), which is phased, so the project is re-scoped and re-budgeted at the end of each phase allowing for a more realistic statement of work and budget. R. Perry concurred. C. Hulburt noted to consider funding to decrease industry risk and that workforce is desperately needed. R. Perry noted that those are areas where IOOS could help. D. Merritt noted that there's a fear of breaking some kind of contractual rules or being unfair to one business or which stifles industry's ability to have just honest conversations with people. Educating scientists on what they can and can not share would be beneficial.

R. Perry asked the panelists for their number one suggestion for IOOS as it thinks toward how to best utilize the IRA and BIL funds going forward. M. Womble recommended setting up something that's lasting with staying power so that it can't be eliminated after IRA and BIL funds are gone. D. Merritt agreed, adding for IOOS to continue standardizing quality pieces and format. C. Hulburt recommended to leverage funds by funding innovation across the vendors towards whatever critical priority IOOS has. J. Klinke recommended thinking about incorporating funding or resources for pilot programs that allow continuous innovation, not just when NOPP is active. K. Zaba recommended keeping industry in the loop and letting them know what you need and they'll try to meet those requirements.

West Coast Ecosystems

Kristen Koch, Director, NOAA Southwest Fisheries Science Center

K. Koch presented on the Climate, Ecosystems, and Fisheries Initiative (CEFI), a cross-NOAA effort to provide climate-informed advice for marine resource management and community adaptation. The IRA has provided funding to National Marine Fisheries Service (NMFS), Oceanic and Atmospheric Research (OAR), and National Ocean Service (NOS). CEFI has four requirements: reliable delivery, operational production, increased decision-maker capacity, and

targeted research and observations. It's a decision support system. There are five regional teams: Arctic/Alaska, West Coast, Pacific Islands, Great Lakes, and East Coast.

K. Koch further discussed connections between CEFI and IOOS. CEFI is focused on modeling and modeling capabilities. CEFI has a National Observations and Research Team for identifying observation requirements to project how ecosystems will respond to environmental change. The former correlative models need to be improved. IOOS can help with data assimilation into models (e.g., subsurface glider data for temp anomalies, HFR and satellite data, and model validation). IOOS could consider expanding into areas important to Living Marine Resources by working with the regional NMFS. IOOS could provide data for Ecosystem Status Reports (ESRs) and Environmental Indicators to Fishery Management Councils at one-month to two-year time scales. NMFS is updating its Data Acquisition Plan, and IOOS may have platforms that should be included.

D. Costa asked if there are other datasets within NMFS that we could assimilate into IOOS. K. Koch responded that the West Coast NMFS uses Ocean Tracking Network (OTN) telemetry and Ocean Biodiversity Information System (OBIS). There are datasets for marine mammals and salmon that could be useful for animal tracking collaborations.

E. Howlett then asked how much NMFS data flows into IOOS beyond the Animal Telemetry Network (ATN). M. McCammon said there are some data assimilated within IOOS. It's more how do IOOS data feed into the ESRs. She asked how IOOS can help streamline providing information to the Fisheries Management Council to make decision-making easier so it's more transparent and quantitative. K. Koch responded that a lot of ESR data are IOOS-related or come through IOOS, mostly on the physical and chemical side. NMFS is taking steps to streamline the ESR. They added a climate change appendix a number of years ago. They are hearing requests for targeted products to help the Councils with decision-making. H. Ruhl noted the Trinidad headline data is being integrated into the CeNCOOS data streams and the rockfish surveys are already integrated. IOOS-NMFS data are mostly regionally integrated, but there are some national level efforts, such as through MBON.

Andrew DeVogelaere, Research Ecologist and SIMoN Program Director, Monterey Bay National Marine Sanctuary

A. DeVogelaere presented on Sanctuary Watch. The National Marine Sanctuaries (NMS) are a network of Marine Protected Areas (MPAs). The Monterey Bay NMS is 6000 mi². NMS promotes multiple uses, including the blue economy. Sanctuary Watch data are served up in a way that is useful for Sanctuary management. They started with MBON and are working on SanctSound and climate vulnerability. Sanctuary Condition Reports have to be done before developing Management Plans, which are supposed to be based on the status of our sanctuaries. But the information is obsolete as soon as it's published, so they are working on how to provide the information more quickly. They are working on infographics through Sanctuary Watch where the scientists or managers can click on the habitat or species they have questions about and see the data for the parameters. The simple graphs are updated as the data come in. The managers find this more helpful than the Condition Reports. SanctSound has hydrophones to help Sanctuaries adaptively manage day-to-day on where the whales are.

A. DeVogelaere then discussed IOOS connections. IOOS are knowledge producers. People in NMS are knowledge users, taking the information and trying to use it to manage and report to Washington, DC and the public. The knowledge producers don't always put the information in a way that is easy to use. Synchro could help with this. They need to look at the questions, timelines and timescales, spatial scales, data availability, and information interpretation. They started this with Sanctuary Watch. NMS can provide stakeholders interested in your data to IOOS. NMS can help with co-development of products. There can be 50+ critical parameters per site, and we need help with making these available. Source and fate of sand, wind energy, animal movement, sound, climate, and biology are among the key parameters. There needs to be iterative discussions to get from what the decision-maker explains as their needs to what they really need.

S. Rayder asked if NMS would pay for the IOOS data they use. A. DeVogelaere wishes they had funds to pay for it because they need it. D. Costa added the National Park Service and NMS get extremely different funding to manage their spaces.

S. Rayder asked if NMS has any input into what data the RA collects and if a formal process for requirements would help. A. DeVogelaere responded that the NMS and CeNCOOS have a collegial relationship. D. Costa asked if there could be an agreed set of requirements across the Sanctuaries that could be part of IOOS. A. DeVogelaere thought there could be and added that they are working on a set of climate requirements.

E. Howlett liked the terminology of IOOS-certified flexibility. A. DeVogelaere stated they are not allowed to share data when they don't know all the metadata, so "IOOS-certified flexibility" is a way around that. The ONMS also uses NMFS data. R. Perry noted the resources in the Monterey Bay NMS are different from others and that Flower Banks NMS collects a lot of data that isn't integrated into the IOOS system.

J. Virmani commended the wonderful presentation and asked what the appetite is for new technologies like eDNA. A. DeVogelaere responded they have a lot of interest in that. Within his office, they use data from eDNA, animal telemetry network, and gliders. K. Koch added NMFS collects a lot of data in the omics realm. The two West Coast Fisheries Centers are further ahead in collecting and using omics. Steve Lindley said the Southwest Fisheries Science Center is exploring all sorts of technologies, though ships dragging nets will still be used. H. Ruhl said CeNCOOS is collecting eDNA in three locations. They work with Sanctuaries to develop an information matrix to identify data that could feed into their process. There is an MBON paper about it that helps guide CeNCOOS, and they refresh it regularly. C. Gouldman said this work by ONMS relates to the work IOOS has been trying to do with marine life observations. ONMS is a customer of IOOS and there can be documented requirements to support that.

C. Gouldman asked K. Koch if there is a way to coordinate on their uncrewed systems data because IOOS has the glider DAC operating. K. Koch responded that they are just getting started with internal teams on how they will use IRA resources. Some will go into uncrewed systems. At some appropriate point, it would be good to talk to IOOS across the regions. K. Koch asked for further clarification about the Marine Life DAC. M. Mackenzie responded that they are looking at how to integrate the Animal Telemetry Network (ATN) and MBON. A DAC is not yet established, but they are working on what is needed to meet the needs of stakeholders.

John Haskins- Water Quality Monitoring Scientist, Elkhorn Slough National Estuarine Research Reserve

J. Haskins presented on the Water Quality (WQ) and restoration programs at the Elkhorn Slough National Estuarine Research Reserve (NERR). He also does drone work for restoration monitoring. The Slough has experienced a lot of tidal degradation and is a sediment-starved estuary. For restoration, they had to bring in sediment to build the marsh up to the elevation level where it wants to live. They used an old map to try to build the channels the way they were historically. They are just starting in phase 3 of the restoration. They push the sediment out and then cut the channels. It takes 6-8 months to push the sediment out.

J. Haskins then focused on the Slough's WQ programs. The NERR has four permanent sites collecting physical parameters every 15 min. They have additional sites through their volunteer program they started in 1989. The Slough is one of almost 30 NERRs across the System. All NERRs collect the same data the same way and meet annually to discuss and plan. All the data are accessible on NERRS website. NERRS has a series of quality assurance quality control (QAQC) stages: provisional, provisional-plus, and then authenticated each year. They have few widgets for data visualization to look at trends and worked with people at the state to develop a WQ report card with thresholds.

J. Haskins spoke to potential IOOS-NERRS collaborations, including HFR data and calibrations, especially to look at discharge and fluxes of sediment transport. Elevation is critical. Sea level rise is a big focus of their restoration. They could collaborate on an inundation calculator of when the water level is above the marsh line. They could collaborate on a WQ Index for the report card and a Current Calculator for local kayakers. It's easy to get into the Slough, but can be very challenging to kayak back out.

M. McCammon asked how closely the Slough works with the Sanctuary on data and data products. J. Haskins responded they work together all the time, but no data products and visualizations came to mind. He believes the Sanctuary uses the Slough's WQ report card. S. Rayder asked how much of the sediment the Slough is adding for restoration is being lost into the Sanctuary. J. Haskins said it's very little to none. Compacting the sediment helps prevent any loss. D. Costa added they don't have many estuaries in California, especially compared to the East Coast. C. Gouldman then inquired about the condition before the restoration. J. Haskins responded that the historic condition was diked and drained. There were cattle on it, but growing grass on that land didn't work well. Then it was reintroduced to fully tidal, and all the sediment sank. S. Rayder brought up the estuary loss occurring in southern Louisiana, and suggested sharing the Slough's restoration efforts with them. S. Rayder asked if the whole NERR system sits down to compare and learn from each other. J. Haskins replied they meet regularly.

John Hansen, Executive Director, West Coast Ocean Alliance

J. Hansen presented on Regional Ocean Partnerships (ROPs), which comprise the Northeast Regional Ocean Council (NROC), Mid-Atlantic Regional Council on the Ocean (MARCO), Gulf of Mexico Alliance, and West Coast Ocean Alliance. They are all regionally specific and tailored to the regions. ROPs were authorized in the National Defense Authorization Act. The West Coast conversation has evolved beginning with the West Coast Governors agreement in 2006. It changed based on changes in governors. The Obama Administration decided to implement the

plan for regional products. This engaged Tribes and moved away from state-led efforts. In 2018, the Trump Administration started the ROPs. ROPs received \$10M per year from the Bipartisan Infrastructure Law (BIL). There's a specific pot of funds for Tribes.

J. Hansen then spoke about the West Coast Ocean Alliance (WCOA), which stretches along the whole west coast. It is a tribal, state, and federal partnership. A central principle was data science for decision-making. It is flexible and responsive to regional needs and is non-regulatory. The WCOA brings the decision-makers together and provides a one-stop shop for the information the decision-makers need. WCOA goals include compatible and sustainable ocean uses; effective and transparent decision-making; comprehensive ocean and coastal data; and increased understanding of and respect for tribal rights, traditional knowledge, resources, and practices. WCOA is working with SCORP and NANOOS on a West Coast Ocean Health Dashboard. OSW is a big topic, and WCOA will host a summit next year to convene OSW decision-makers. WCOA is tracking the development of an OSW science entity. WCOA helps fund the data portal and tries to make connections to IOOS.

M. McCammon noted funds are going through the RAs in areas that aren't covered by existing ROPs. The four ROPs are getting a lot more funding. There should be more collaboration and conversation to avoid duplication of data services. She asked how WCOA collaborates with the three RAs in the West Coast to avoid duplication. J. Hansen responded that there have been regular conversations on how to make data connections. WCOA just hired a data portal coordinator that will help reinvigorate those collaborations. M. McCammon said it's also the stakeholder engagement. Everyone is doing it, and there's a lot of overlap. Many of the stakeholder groups are overwhelmed. E. Howlett noted both groups use different infrastructure and the data are different. It seems to be more synthesized vs. the dense data from IOOS. There still may be data sharing possibilities.

Marine Life Observations Discussion

M. Weise introduced the session, emphasizing the importance of the transition from the ATN community to the Data Assembly Center (DAC).

Megan McKinzie, ATN Data Coordinator, MBARI

M. McKinzie's presentation focused on the goals and use of the U.S. Animal Telemetry Network (ATN). M. McKinzie noted that collected data is archived in the DAC and is seeing growth of about 20% per year. The DAC is still under development, but its data is usable for various users. ATN aims to support regional acoustic nodes and fill regional gaps with OTN/ATN-compatible nodes. A cohesive national node network is an eventual goal for ATN, which requires regional cooperation. Various species of animals can be used to generate ocean profiles containing ocean and biological data points, but the health and safety of the animals is taken very seriously.

M. McCammon asked who funds DAC now. M. Weise responded saying that IOOS mostly funds DAC. BOEM does not fund it, but is part of the steering committee. Developing sustained support is a priority. D. Costa added that there are other agencies that have the potential to fund the program based (ex. NSF projects that use the data, but NSF doesn't contribute). S. Rayder asked about the project's total budget. M. Weise estimated the budget to be around \$1.6-1.7m.

Francisco Chavez, Senior Scientist, MBARI/CeNCOOS

F. Chavez began his presentation, representing MBON. He mentioned that we have a fragmented knowledge of marine life and lack the sensors needed to fill the gaps. One of the major goals is to understand the drivers of marine biodiversity change. Most work done by MBON falls under the ideas of observations and modeling, developing new technologies, and delivering information. MBON contains a collection of working groups (e.g., eDNA, and BioTrack). F. Chavez provided recommendations on what resources are necessary for IOOS and MBON to advance.

M. McMammon asked if MBON focuses more on non-megafauna life and how MBON coordinates with the other agencies. F. Chavez stated that MBON seeks to work with everyone who is observing life in the sea. The challenge is larger than just one program. The strategy is to help establish a standard approach for data collection. MBON does not focus on a specific species. D. Costa added that working on large projects like this would be much easier if it was integrated. F. Chavez agreed, but noting that it is difficult because each group collects data differently. M. Weise added there is some coordination across agencies, but it needs to be further refined. J. Virmani asked if it's possible to look at viruses or bacteria. F. Chavez responded that they look at microbes, but not viruses or bacteria. H. Ruhl stated that MBON has become more inclusive by trying to integrate more data. CeNCOOS has also worked with state funding to integrate data from MPAs. F. Chavez responded, saying that RA support to get biological data into one database would be very beneficial.

Michael Weise, Program Officer, Office of Naval Research

M. Weise presented on eDNA and its potential to revolutionize our ability to monitor marine species. M. Weise recognized the expertise that was present in the room, but wanted to provide his experience and insight on the topic. A brief overview on eDNA was provided, including applications like biodiversity monitoring, rare/endangered species ID, etc. Two objectives were to improve the ability to detect and classify marine mammals to support the Navy's risk assessments and compliance monitoring and to develop scalable, autonomous "genomic weather stations." Applications and challenges were also mentioned. M. Weise explained the research strategy and community building process. Discussions on cross-agency efforts to coordinate data guidelines are in process. An eDNA Strategy draft is expected to be complete by December and the official strategy is expected to be complete by Capitol Hill Oceans Week (CHOW) 2024.

S. Rayder asked who M. Weise works with in USGS. M. Weise said that he works with Maggie Hunter along with others. S. Rayder lightly discussed a possible integration opportunity. M. Weise agreed and took note of the idea. K. Goodwin noted that ReadyNet (an eDNA observing system) is being developed with USGS and MBARI. F. Chavez suggested thinking larger. M. Weise noted that a Request for Information will be open soon to collect input on eDNA Strategy.

Lindsey Peavey, West Coast Region Sanctuary Soundscape Monitoring Project Coordinator, NOAA West Coast Regional Office

L. Peavey presented on how passive acoustic data is being collected in marine sanctuaries. Sanctuaries are broken into three regions: Pacific Islands region, West Coast region, and the Eastern region. Baleen whales, explosions, and vessel activities are examples of acoustic

monitoring points. L. Peavey discussed how sound data is collected and how stakeholders were included to brainstorm what types of sound could be heard. It was noted that not every region has passive acoustic monitoring capabilities, but data can be compared across regions on the official website. Kudos were given to IOOS for their investment in data management and cyberinfrastructure. L. Peavey recommends that we use the developed infrastructure to expand into other areas of study like ATM, eDNA, etc. Examples for how sound data was also used to support management and policy were provided.

D. Costa mentioned that all regions seem to use the same requirements and data schemes, making it easy to compare across regions. This is a perfect example of the benefits of a standardized data collection and management system across regions. M. McMammon asked if they can incorporate data from private industry. L. Peavey stated that it is possible, but it hasn't been done much. She also discussed work being done to engage tribes in an effort to support co-management. R. Perry mentioned that offshore wind will be required to do offshore acoustics in their lease, also adding that if BOEM and NOAA can develop a blueprint for the technical process for acoustic monitoring, it would be a major success.

Patrick Daniel, Associate Staff, UCSC/CeNCOOS

P. Daniel presented information regarding phytoplankton observations. P. Daniel claimed that large-scale events establish the need for a rapid response plankton ocean observation program. CalHABmap was developed to create a weekly harmful algal bloom monitoring report. The California Imaging Flow CytoBot (IFCB) Network was also developed to monitor the presence of species that are known to cause harmful algal blooms. Classification of images received through the CytoBots was explained.

M. McMammon asked if the data being incorporated were part of the National Harmful Algal Bloom Observing Network. P. Daniel responded that they are. E. Howlett asked when the data pipeline will be complete. P. Daniel said the data pipeline is somewhat operational. E. Howlett also asked about the development of the machine learning model. P. Daniel said that the model is trained, and the next step is to generate defensible statistics using the model. C. Edwards asked how much the methods of classification and thresholding are applicable for other systems. P. Daniel said the techniques and code are applicable, but the challenge is swapping out the images.

G. Canonico from the IOOS Program Office provided some final thoughts for the session. She expressed the value of receiving updates on the partner projects that compliment the goals of IOOS. In order to respond to community needs, IOOS needs to align their processes better across service providers. Ways of engagement include aligning operational marine life measurements and being engaged in partners' active monitoring data streams. The key is linking species information or oceanographic information. Touching on an earlier discussion, she views requirements as a critical piece of effective prioritization and resourcing for marine life. She noted there were a lot of lessons learned in terms of partnerships with NMS and how to work with managers on the ground. The tools co-developed with Sanctuaries are resonating with other groups like IEAs and others that have requirements for place-based management. She pointed out that IOOS is receiving requests for national and global marine life data to inform climate response, not just on the local or regional scale. There will be a NOPP Marine Life Forum

held later this year, which will work towards the development of a national marine biodiversity strategy.

PWG Working Session - Marine Life

O. Schofield stated the major idea for the group was to promote standardization for biological measurements. D. Costa added an aspect of this topic is the synchrony among the RAs in terms of requirements and data. He asked how effective the physical measurement requirements are. That limits the ability for doing biological measurements. ARGO was mentioned as being a good starting point for data archival. GOOS has worked on spec sheet requirements for various biological species. Another question for consideration is if the RAs are aware of that work by GOOS - if so, are they implementing the requirements or if not, why not. D. Costa also brought up the idea of why we should care about the idea of an integrated system. He noted that other agencies are also collecting biological data, so another objective is to identify what data is out there, then how to organize it.

S. Rayder asked if all IOOS data goes to the National Center for Environmental Information (NCEI), to which C. Gouldman replied no it doesn't because NCEI can't handle the IOOS data fast enough. O. Schofield added that NCEI has difficulty with biological data in particular. S. Rayder brought up the Comprehensive Large Array-Data Stewardship System (CLASS, part of NCOS), stating it wasn't fully funded. He said people focus on the "shiny new item" but not what to do with the data it collects. NOAA has "data mausoleums"- data comes in but doesn't come out. J. Virmani added that other agencies lose data as well. Some of it is due to how the data is archived. S. Rayder proposed that the committee think about what recommendations can be made

M. McMammon asked what the timeline is, and what are we trying to accomplish with this working group today. D. Rudnick asked which data responsibilities are appropriate for IOOS and where the boundaries lie, comparing to NMFS. One of IOOS's responsibilities seems to be HABs. S. Rayder noted that NMFS will be careful with what they share. S. Graves commented that one emphasis is the stewardship of the scientific community for certain types of data. The sustained coordination has greatly helped NASA. G. Canonico suggested considering plankton community data beyond HABs, as brought up in the presentation by P. Daniel. C. Edwards asked about the capacity for doing the work proposed in previous sessions. Bandwidth should be considered. M. McMammon suggested that IOOS could do something with place-based data portals. There's not a common platform that shows region-wide or national ocean conditions. J. Virmani agreed and mentioned that a nationwide platform that shows ocean conditions would be a great way to show what IOOS does. H. Ruhl added that ATN has a national DAC and SantSound is ready to scale on a national scale. It can be done and will be done with IRA money. J. Biggs proposed to move into the fisheries forecasting, which feeds into sanctuary work. The data is already there. Combining data streams could help with coastal resilience. J. Virmani added that information is provided by the NWS. J. Biggs mentioned that PacIOOS manages that information in the Pacific.

S. Rayder checked in with the chairs to see if they were getting what they needed and proposed to refine the scope of discussion. O. Schofield suggested that they should propose some recommendations and submit them to the working group. J. Virmani added that there is an ocean component in the UK Met office, which sits in the ministry of defense. S. Graves reminded the committee that they're recommending to both IOOS and IOOC, and they should

send recommendations to both. S. Rayder mentioned that not every nation has a “NOAA.” He also asked if there was anything else that D. Costa or O. Schofield needed. D. Costa asked if there are examples of science used in management proactively, to get to the value add for the public. G. Canonico provided insight regarding uptake of information used in management: Translating data from MBON into a product with utility was challenging. MBON may not be doing it in an effective way, and may need to consider changing our approach regarding how we interact with users. M. McMammon emphasized the need for social scientists and regulators.

S. Rayder raised the question of what the IOOS concept of operation looks like. He was concerned that the vision of IOOS was to be “everything to all people.” R. Perry responded that IOOS is an honest, neutral broker of data and that the users should be able to go to IOOS for the data needed, rather than IOOS being “everything to everyone”. C. Gouldman added that the concept of operations has matured such that a service delivery framework has developed. The service is provided and relies on consumer feedback. R. Perry mentioned that having everything in IOOS would help comply with regulations. C. Gouldman mentioned that it would require a bunch of work because it requires collaboration with the rest of NOAA. C. Gouldman mentioned that NMFS would need to be incentivized to share data. D. Costa added that a NMFS biologist might argue that it’s not useful to provide data because it would require interpretation from NMFS or the data might be misused. He emphasized that he doesn’t necessarily believe that argument. G. Canonico encouraged the committee to remember the “I” in IOOS and how IOOS can organize the data from our other partners (i.e. outside of NOAA). IOOS could have a real impact if the community prioritized data requirements and standardization. D. Costa asked if there are at least some common standards to make data integration feasible. K. Yarincik mentioned that the RAs do have tools through their portals, but that’s also part of the new blue economy concept. J. Virmani mentioned that the RAs still have a critical role, but the unified front needs to be demonstrated. J. Virmani also, why is NMFS data hidden when it’s NOAA collected. There are also some data hubs being developed internationally. If the government doesn’t do it, then our collaborations may use those instead. D. Rudnick added that some NMFS data is old and not electronic. NMFS biologists are also just private with their data. He pointed out that the Southwest Fisheries Science Center (SWFSC) developed ERRDAP, so improvements are being made. He recommended the committee should also have a NMFS representative in this discussion. O. Schofield agreed with Dan that there are improvements, but it should get better and IOOS could probably help. J. Biggs expressed concern about some NMFS data that has never been reviewed outside NMFS, which is not the “best available scientific data” and is being used in regulatory decisions. There are negative impacts to the territories because of this. S. Rayder mentioned a recent case involving NMFS regarding collected data on right whales. R. Perry mentioned that the provided example is a strong reason to have leadership request data from NMFS. M. McMammon suggested using the emphasis on the coastal climate signal to collect the necessary data sets.

PWG Working Session - NOPP

K. Yarincik initiated the NOPP PWG working session as facilitator. She noted that she is not the chair of the working group. She highlighted 3 topics for the session: AI and machine learning (i.e., how will IOOS to take advantage of AI and machine learning to improve data service and how will future users of IOOS use AI tools to access ocean data and information and then how should IOOS prepare for that), data buys (i.e., does IOOS intend to use data buys and, if so, how does the IOOS intend to use data buys to fill gaps in ocean observation), and improving

interagency participation in IOOS (i.e, how does IOOS fit into the larger picture of national multi agency observing programs that must together and in coordination be enhanced and leveraged in ground to meet all of the applied needs there are for that information).

M. McCammon asked how these three topics relate to NOPP. K. Yarincik replied that the third topic relates because it is about interagency participation, but she isn't sure about the other two. Data buys is certainly relevant to IOOS, but perhaps not NOPP specifically. B. Winokur mentioned that Saildrone is an example of a data buy. One takeaway he had from the industry panel was what is the business case for industry to participate in NOPP, particularly as NOPP proposals are one-off. One business case could be AI and machine learning. B. Winokur also highlighted a previous question about the lack of participation from other agencies in these conversations.

K. Yarincik proposed the idea of a NOPP 2.0, but it would need further guidance. D. West provided additional details about the formation of NOPP and its partnerships. He emphasized that NOPP is an effective tool for the IOOC. J. Virmani responded to Bob's question about what industry gets out of NOPP. She wondered if there is a way that NOPP can help to de-risk their business. K. Yarincik emphasized the need to stay within the scope of IOOS. She mentioned that it is scalable but it's also making sure that if we're making that recommendation, that IOOS will buy it. J. Virmani noted that it also feeds into the data buy question since industry is putting money into engineering. R. Perry agreed and added that she sees NOPP as a vehicle for when congressional appropriations are not available. K. Yarincik mentioned the challenge that every agency funds things differently, but there may be a way to navigate that.

D. Rudnick stated his interpretation on what he heard from the panelists in terms of what NOPP is good at, which was initial R&D. Perhaps this could be emphasized to the IOOC as a way to promote additional investment by them. He suggested informing NOAA about the issue the panelist brought up around scalability. J. Virmani concurred, asking if NOPP can be used for R&D for scalability. D. Costa mentioned that NOPP money came from existing programs, limiting its ability to facilitate new NOPP initiatives. M. McCammon mentioned that the goal of NOPP was not just to blend interagency money, but also to bring in philanthropic and industry money. She also questioned if the needs are short or long term. B. Winokur concurred and reintroduced the question of what the benefits are to partner with NOPP from a business perspective. He also agreed with the idea to get the IOOC involved. D. West mentioned that NOPP isn't just for R&D, but all ocean issues. C. Schmaus noted that DOE does not get new money to participate in NOPP. She also mentioned that for the recent NOAA mCDR Notice of Funding Opportunity (NOFO) where DOE contributed funds, there was no blending of funds and DOE still had to go through the Interagency Agreement (IAA). NOPP doesn't make the administrative process of blending agency funds any easier. NOPP has been helpful to get expertise from other agencies.

S. Rayder asked what the committee wants NOPP to achieve. He mentioned common data architecture across NOAA as a theme he's heard during the discussions. M. McCammon provided an example of low-cost water sensors being done in Alaska. NOPP tends to be for larger platforms, but it could be used for smaller but more scalable platforms like the low-cost water sensors. K. Yarincik stated that NOPP can do that strategically, then put investment behind it. D. Rudnick said the issues here boil down to scalability - some of the larger platforms

discussed could significantly decrease in cost if produced at a higher scale. J. Virmani mentioned that there's a global consumer base, but they're expensive and not easy to use.

K. Yarincik redirected the committee to the topic of data buys. S. Rayder stated that data buys are guaranteed, it is a matter of identifying what NOAA should do in-house and what it should buy. A major concern is if the research community can have access to the data. NOPP can be a testing group for data buys and getting them to a readiness level for NOAA to buy it. D. Costa said there are other models for scalability, such as an agency buying large quantities of an item and then distributing them to the community. M. McCammon noted that the RAs are part of external program data buys and that they should be invested more heavily. S. Graves noted there are many different models for doing data buys.

D. Rudnick asked what, if anything, the committee would like to do around the draft Weather Act reauthorization bill that includes language about data buys and IOOS. There was agreement that the Committee can offer support for the bill to NOAA and/or the IOOC, but not to the Hill. D. West raised a concern about NOAA being reduced in size if it starts buying data from industry. S. Rayder countered that some military branches have done this but have not been scaled down.

S. Rayder asked what is the federal ocean observing backbone, and what makes it distinct. D. Rudnick expressed concerns regarding data buys. His first concern was public access to the data. S. Rayder asked if industries are buying data, and they have better data than the government, how do you reconcile that? C. Gouldman stated to not buy it. R. Perry added that industries try to give our better data to the government and the government won't take it. She expressed concern with the data buys because the government can't handle data that could be given to them for free right now, let alone purchased data. J. Virmani asked if industries can give it to the RAs. R. Perry stated that the RAs do not have the operability or the data management resources. She added the fundamental issue here is more about how NOAA and/or the RAs could handle the data influx. D. Costa noted that being able to hold data is a fundamental issue here and it relates back to the earlier discussion on marine life in that collecting the data in a standardized way would make it easier to assimilate.

PWG Working Session - Enterprise Excellence

M. McCammon reviewed the slide deck on the activities and status of the Enterprise Excellence PWG, including the completed or proposed activities for each element of the IOOS Enterprise. E. Howlett complimented the chairs on their organization of a complicated topic. J. Virmani asked where industry fits and M. McCammon replied they fit into the Stakeholders section. She noted that while they can't do a survey, they can hold informal listening sessions or one-on-one conversations. S. Rayder suggested NIST as an agency to consider, as they are doing climate standards. He posed a question about who the IOOS stakeholders should be in the future, suggesting Google (Steve Moran).

J. Biggs noted that social science is missing from the survey questions slide, such as what the scales of 1-5 represent, but the chairs assured him such explanations were clear in the actual survey. Referring back to the proposed survey to the RAs on strengths and weaknesses, D. Rudnick said clearly the RA strengths are their connections to local communities. However this is also a weakness in that there aren't clear national priorities for the regions to participate in.

One area where this scalability has been successful is with HF radars. The RAs could do better on what national priorities they all agree on. M. McCammon agreed that most RAs are doing work in similar areas, like marine life for example, but they don't have an agreed upon data product to be aggregated and presented as a national product. C. Gouldman said the IOOS Program Office would like to better articulate the national products and services as a result of the IRA funding. He noted the presentation by National Marine Sanctuaries where they all used the same tool. He said we could start with figuring out how far apart the RAs are and then discuss and iterate on how they can come together. M. McCammon said they would be interested in supporting this, if they were allowed to bring in additional expertise.

C. Edwards added that this group had also discussed stakeholders who are involved now that might be missing in the future. J. Virmani asked if the IOOS Enterprise has enough of the AI or machine learning, and tech companies involved. S. Rayder suggested the National Institute of Environmental Health Sciences as another stakeholder to consider. S. Graves raised another aspect of data accessibility and usability.

DAY 3 - June 29, 2023

Fleet Numerical Meteorology and Oceanography Center (FNMOC) Briefing

Commander Steve McIntyre, Executive Officer, FNMOC

K. Arzayus welcomed everyone to the final day of the meeting. Commander S. McIntyre was introduced and given the stage.

S. McIntyre provided a brief on FNMOC. An explanation of the chain of command was provided. S. McIntyre emphasized the heavy reliance on partnerships. A distribution of FNMOC resources (e.g., headquarters, expertise, and employees) was provided. The FNMOC mission flow consists of observations, analysis via supercomputers, global modeling, then regional modeling. Models include atmospheric, oceanic, and coupled. Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) is the "workhorse" for regional modeling that shows a 4-day forecast. An explanation and future vision of the Navy Earth System Prediction Capability (ESPC) was also provided. The model is expected to provide a 7-day coupled (ocean and atmosphere) model in 1 day. Common challenges for the program include budget stability, maintaining a technical workforce, managing big data, being an information-based mission, and partnerships.

M. McCammon asked how much of the modeling resources are used for predictions at facility sites both nationally and internationally in terms of climate impacts. S. McIntyre responded that their models are not tuned for climate prediction. The mission is focused on near-term operational impacts. M. McCammon also asked how much bathymetric data is shared with the public. S. McIntyre responded that the bathymetric collection is focused on strategic sites worldwide, but he was unsure how much data is available for public use. They do rely on NOAA bathymetric data in certain areas. D. Costa asked how much data is archived. S. McIntyre responded that the Navy archives their Tau-Zero analysis (each data simulation that creates a current state of the atmosphere), but archiving big datasets has been a challenge with the quantity and size of the datasets. D. Costa also asked if we still rely on allies for satellite

coverage. S. McIntyre responded that we still rely on our partners (NOAA GOES satellites, Europe, Japan, etc.). SpaceForce has also been important for identifying and filling in gaps in coverages, such as with tropical cyclone forecasting.

E. Howlett asked how much information is within the unclassified level. S. McIntyre responded that most operations in Monterey are at the unclassified level. Models involving ship locations are done at the secret level. E. Howlett also asked where cloud infrastructure sits in the strategic vision. S. McIntyre responded that their partners like NOAA and AirForce are moving to the cloud. The FNMOC community is trying to understand what their requirements are and what it would take to move the amount of data they have to the cloud. They are looking at different options, such as moving all data and compute to the cloud or just moving the archival data to the cloud. H. Ruhl talked about the current work to increase resolution on certain models, and the trade-off of resources to dedicate to that work. He added that he would be happy to share the West Coast-wide ocean forecast model (WCOFS) with S. McIntyre. C. Gouldman asked if it's possible for them to identify data gaps, then relay that information to partners. S. McIntyre said yes, and there is a tailored global sensing strategy coordinated with the naval oceanographic office for glider and buoy deployment. This coordination goes through the Naval Meteorological and Oceanography Command (CNMOC), and ultimately through the Navy Deputy to NOAA. D. West also provided clarification about the access to naval ocean data. He also discussed the use of archival data for international accident investigations.

FAC Planning - Future membership and succession planning

K. Arzayus reviewed the slide deck on the AC Membership. She said that the solicitation for new members would likely be published this fall. Members of the IOOC serve on the selection panel. She asked the members for their ideas on asking one of the current members who will remain for a second term to be chair, or wait and see who is nominated from the pool of new members. There was general agreement that the new chair should be an existing member and the new vice-chair should be a new member. M. McCammon suggested that the new members attend the spring public meeting if possible to get more up to speed before they join officially. K. Arzayus clarified from questions that while Dr. Spinrad makes the final decision about the next chair, the IOOS office makes a recommendation based on input from the AC members.

There was extensive discussion about the possibility of staggering membership so that such a large number of the Committee isn't rotating off at the same time in the future. K. Arzayus noted there are pros and cons to staggering. The process for bringing on new members is time consuming and the AC Charter requires that members be solicited every 3 years.

B. Winokur brought up how in the last membership process, there was a delay due to the Charter needing to be renewed. K. Arzayus said the charter previously had to be renewed every 2 years, but now it's only every 5 years, so it will not interfere with the membership process.

Returning to the discussion about staggering membership, S. Rayder suggested bringing on 10 new members this cycle. Then at the end of that cohort's first term, have a discussion as to if all 10 should be renewed, which may help with staggering long term. J. Biggs asked how many people applied to be members last time (no answer).

The AC held a vote to decide if they should bring on 10 new members to replace those rotating off. All members present agreed with no disagreement. The IOOS office will ask the 5 members in their current term if they want to serve another term, to then have a discussion about the next chair.

K. Arzayus moved on to the Membership Balance Plan slides. R. Perry asked if the members rotating off could serve as ex officio or non-voting members to help with the transition. K. Arzayus noted there are ex-officio members now from the IOOS Association and IOOC, but it could be considered for AC members.

The following topics were discussed as expertise to consider for the next round of new members: Great Lakes, philanthropic (ocean foundations/ocean NGOs), someone closely involved with RAs (since losing M. McCammon as former RA Director) or IOOS Program, tribal interests, fisherman industry in the northeast involved in permitting process of offshore wind, boating industry, blue economy (including AI/ML), social science, ROPs, tech industry (ex. Steve Moran, Google), science communication and outreach (ex. Kathleen Ritzman, Scripps). M. McCammon said it is up to all members to help with recruitment.

S. Rayder said he heard over the course of the meeting the need to involve other agencies, like IOOC member agencies. There is a question as to if other federal agencies can be on the AC. D. Rudnick noted we have the IOOC members as ex-officio, which is supposed to be the connection to the other agencies, but it currently isn't effective. J. Virmani added that having an IOOC agency as a full member would help them be more invested. There was a comment to have more topics on the agenda that would be of interest to IOOC agencies.

The members reviewed the Membership Matrix. B. Winokur suggested changing the name "ex-officio" to "liaison" to encourage greater involvement. K. Arzayus said we need to identify the requirements for their engagement. D. Rudnick noted that the ICOOS Act states how ocean observing is more than the IOOS Program Office, and there is concern about who exactly this AC is advising. E. Howlett recalled that the DMAC Steering Team was very good at interagency collaboration. He asked if there had ever been conversations about collaborating with the NOAA Science Advisory Board's Data Archiving and Access Requirements Working Group (the response was no). B. Winokur suggested having an action item for IOOC at every meeting to keep them engaged. M. McCammon said this could be a recommendation out of the Enterprise Excellence group. She also suggested at the next meeting to have the IOOC agencies report out on how they are using BIL/IRA funds and connections to NOAA.

Open Discussion

K. Arzayus started with plans for future meetings. The next meeting could be in the October to January timeframe to be a working session for the PWGs. She suggested the next set of recommendations be shorter (i.e., two per working group). There may be an opportunity for the AC to contribute to the pan-regional topics for the IRA funding. C. Gouldman stated there are two components of the IRA funding that could be discussed here. First, the AC could help define a set of national service lines for all regions to contribute to, which would require input from the AC sooner than later. Second, the AC could contribute to the IRA engagement calendar in the next 3-4 years, which would not need to be done so quickly. M. McCammon asked C. Gouldman if the AC should make a recommendation that they'd like to be involved, or if the

discussions will just happen informally, to which C. Gouldman responded the latter. D. Rudnick said a formal recommendation isn't needed, but suggested more of a dialogue with the RA Directors regarding the IRA funding to encourage them to consider the national impact and priorities (i.e., have a national footprint), not just regional. D. Costa and O. Schofield voiced agreement. C. Gouldman asked H. Ruhl and J. Morell, as RA Directors, if it would be helpful for the AC to convene discussions on this. Both agreed such conversations could be helpful. C. Gouldman asked if there is a recommendation here for the AC to meet with RA Directors, to which D. Rudnick said they could but really they just want to emphasize this incredible opportunity with IRA funding and for the RAs to think about this national footprint.

M. McCammon suggested a recommendation such as "The AC met and acknowledges the \$40M in the RFA dedicated to national and pan-regional projects is a unique opportunity to enhance the national program and the FAC urges the RAs to develop strong programs and offers assistance." J. Virmani asked if these recommendations were going to the IOOS Program Office or the RAs. H. Ruhl added that the RAs will need time to consolidate their ideas and they need to know the final timeline from the RFA, but that this is a unique opportunity. K. Yarincik said the IOOS Association is meeting with the RA Directors on July 10-11 to begin discussions about this, and voiced a concern about how public the interactions between the RA Directors and AC members would need to be. Several members stated these would be informal interactions. M. McCammon said the RAs could ask the AC members to review proposals (informally, not part of public meetings to avoid confidentiality concerns raised by H. Ruhl). D. Costa added that NSF and ONR have in the past held public meetings to get input of upcoming project solicitations and get people thinking. C. Gouldman added that the IOOS Office will be holding webinars after the RFA is released which will be public. D. Rudnick said this is informal advice for the RAs to think about how this funding contributes to the country, not just their region. M. Murray said the AC could make recommendations on what topics could be considered for pan-regional/national projects, which could be done prior to the RFA release. C. Gouldman concurred. M. McCammon offered to draft such a recommendation but H. Ruhl said that timing after RFA publication would be more beneficial. There was some agreement that the recommendation supporting the pan-regional IRA opportunity would be informal and passed on to the RA Directors through the IOOS Association and the RA Directors present (i.e., not an official AC recommendation). M. McCammon pushed back some in that the intent is not for an RA to work with a new, nearby partner, but look bigger to the national scale. S. Graves stated that RAs could come back to the AC with their ideas on the pan-regional topics for input, but H. Ruhl said those topics would be better coming from the IOOS Association. S. Rayder suggested that the RAs need to meet more frequently, which will help avoid them becoming competitors. J. Virmani suggested something like the Sanctuary dashboard to be able to compare the regional work by the RAs, particularly around the climate signal.

The discussion moved on to future AC meetings. S. Rayder noted that the American Meteorological Society (AMS) is trying to move into the oceans and their next meeting is in Baltimore in January 2024. He asked if the next AC meeting could be in-person in connection with that? It could be an opportunity to showcase what IOOS and the regions contribute. C. Gouldman added that IOOS has submitted an abstract for an ocean enterprise/new blue economy town hall. The AC meeting could dovetail the AMS meeting and the AC could attend this town hall together. S. Rayder said NWS did not receive much IRA/BIL funding and some of the IOOS IRA funding will be executed by this time. So IOOS can offer support in terms of

operational capability. There was overall consensus for this next meeting to be in-person (regardless of location/date). S. Rayder also suggested waiting until early February to align with the release of the President's Budget. M. McCammon stated she didn't want to wait until January for the next meeting as the PWGs have created a lot of momentum. At a minimum, there should be a virtual public meeting between now and January. K. Arzayus added that the meeting around AMS could just be 1 day, with the spring meeting in-person in May/June to deliver the final recommendations to Dr. Spinrad.

M. McCammon asked C. Gouldman if the AMS meeting makes sense as a forum to engage the IOOC agencies, to which he responded no. It would make more sense to have a separate meeting with them. S. Rayder asked if the AC can schedule briefings with the OMB or the Hill. K. Arzayus said she thinks OMB would be fine and M. McCammon added ORAP previously met with OMB. S. Rayder asked who was attending the Oceans 2024 conference and about four members raised their hands.

There was further discussion on the October meeting being virtual or in-person, and if the January meeting was necessary. C. Edwards said October is difficult with teaching. M. McCammon added they haven't had a chance to reflect on the NOAA Response to their previous recommendations and K. Arzayus said a deeper analysis could be incorporated into the October meeting. The final decision was to have a hybrid meeting in October, no January meeting around AMS (but encourage members to attend the IOOS town hall), and an in-person meeting in May/June.

Meeting Wrap-up: Actions and Next Steps

The members did a lightning round around the room for final comments.

- B. Winokur- He agreed with comments made so far about the next meetings. He has a concern about what the recommendations could be for the NOPP PWG.
- D. West- No comments.
- J. Morell- He agreed with the recommendation about working with the RAs on the IRA funding opportunities.
- D. Costa- He likes in-person meetings.
- C. Edwards- Succession planning will be the main focus over the next 6 months.
- M. McCammon- She agrees about in-person meetings. She acknowledged the importance of funding to the national office, not just funding for the regions.
- J. Virmani - Thanks to the IOOS and CeNCOOS staff for the meeting. She thought the presentations were well thought out, but there could have been more breaks in between.
- K. Yarincik- Thanks to the IOOS program office and she appreciates the opportunity to participate.
- D. Rudnick- No comments.
- J. Biggs- He has a concern about capacity with his workload with his day job. Getting his input outside of an in-person meeting is difficult. But he is grateful for the support from the staff.
- H. Ruhl - MBARI and CeNCOOS were happy to host the meeting and be able to participate. He noted the expanding importance of offshore wind for the West Coast.

- C. Gouldman - Praised the IOOS staff for the meeting planning and details. He said E. Howlett did comment to him about the meeting being dense. He thanked the members for their contributions and engagement.
- S. Graves- She offered thanks to the Program Office and MBARI staff. She also thanked Carl for being present the entire meeting and the AC members for their engagement.
- S. Rayder - He encouraged the members to think about succession planning. He noted that the Phase 1 and 2 work plan recommendations will be important for those new members.

Public Comment Period

K. Arzaus read out loud the one public comment received in advance from Allasandra Bianchi at SeaTrac Systems (posted on the IOOS website [here](#)). J. Biggs noted it is important to consider the small companies that contribute to IOOS, as well as the large companies. M. McCammon cautioned against appearing to endorse any particular company. C. Gouldman discussed a project idea that would provide guidance on how ocean technology companies could work with NOAA (i.e. what are the funding opportunities, what are the R&D trends, etc). B. Barlow recommended for representatives from the marine transportation sector to be considered as prospective members of the advisory committee in the future.