California Ocean Observing Systems
Science Impact and Stakeholder Engagement Meeting

Hosted by CeNCOOS and SCCOOS

May 23rd - 25th, 2022
Avila Lighthouse Suites, Avila Beach, CA

The California Ocean Observing Systems Science Impact and Stakeholder Engagement meeting at Avila Beach, CA on 24-25 May 2022. Photo: Courtesy of Cal Poly.

On May 24-25, 2022 the IOOS Regional Associations CeNCOOS and SCCOOS gathered key community members from our Joint Strategic Advisory Committee and Principle Investigators to update on observing and scientific advancements and to chart a path for future progress. Over 70 participants met to exchange information on current activities, highlight existing observational and information needs, and build consensus on regional State of California priorities. Below, we provide a brief summary of the two-day proceedings, including the agenda and links to presentations, discussion jamboards, and high-level emerging themes.

CeNCOOS Governing board member, Dean Wendt, Cal Poly SLO Dean of the College of Science and Mathematics, kick-started the meeting with a warm welcome on Tuesday, May 23rd, 2022.

Meeting Objectives:

1. Provide an update of CeNCOOS and SCCOOS collective accomplishments, data management and cyberinfrastructure (DMAC) capabilities, and end-user applications.
2. Hear about the state of the science in regards to Climate Variability and Change, Ocean Acidification and Hypoxia (OAH), Harmful Algal Blooms (HABs), and Biodiversity and Ecosystem Health, with an emphasis on climate impacts, as well as an update on California's New Blue Economy.
3. Improve strategic alignment among CalOOS contributing partners and share advancements in scientific understanding.
4. Identify knowledge gaps and stakeholder needs.

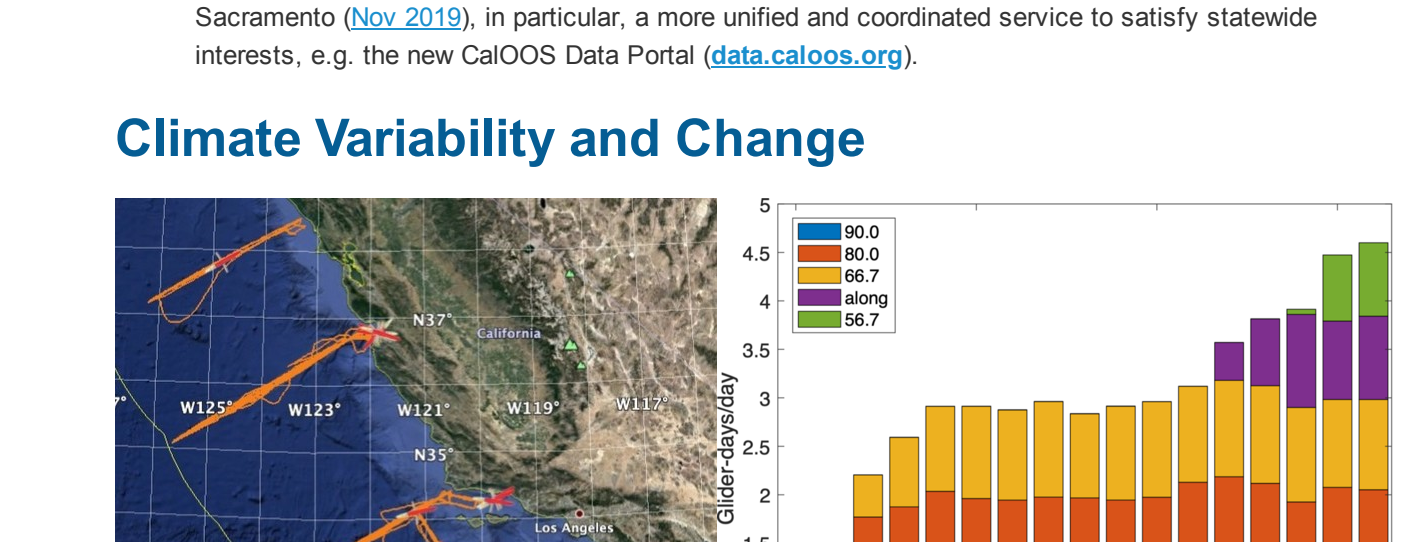
National and Regional IOOS

The U.S. IOOS program continues to grow and work to expand the system's operations and funding. While funding increases seem to be incremental, CeNCOOS and SCCOOS continue to seek out new partnerships and opportunities to make critical investments in hardening and improving their systems.

Key takeaways:

- The State of California continues to provide leadership in climate and environmental investment.
- California is a region of great opportunity and challenge. To meet this challenge, regional and state entities must work collaboratively with Federal and Tribal governments to ensure ocean health and prosperity.
- Our ocean observing community has achieved exceptional growth since our last meeting in Sacramento (Nov 2019), in particular, a more unified and coordinated service to satisfy statewide interests, e.g. the new CalOOS Data Portal (data.caloos.org).

Climate Variability and Change



The California Underwater Glider Network contains three traditional cross-shore sustained lines starting in 2005 (line 90, 80, and 66.7) and three new lines (an alongshore line, line 56.7, and Trinidad Headline; not pictured). The right-hand panel shows the fraction of time that gliders collected data (Glider-days/day). Colored segments identify 5 of the 6 gliders as labeled. A colored segment height of 1 indicates that a glider was collecting data 100% of the time. Images from Dan Rudnick's presentation.

California's coastal ocean is undergoing drastic changes due to climate variation and change. In the past decade, marine heatwaves have become more persistent and extreme. Luckily, upwelling and mixing have attenuated some warm temperatures nearshore. The near-fully realized glider network envisioned by West Coast ocean observing leadership (formerly PacOOS) provides high-quality time series data needed to track anomalous conditions and to deliver information in near-real time. Moorings provide continuous, fixed-point observations required for model validation and to track change over time. Models, particularly assimilative and with a biogeochemical and ecosystem component, enable responsive decision-making.

Key takeaways:

- Time-series from continuous glider transects enable tracking of marine heatwaves, water mass transport, and enable understanding of heat exchange and transfer.
- Cross-platform and technology integration is needed to further the response to marine heatwave and climate impact information.
- Emerging technologies, including environmental DNA, imaging, and sound, offer new tools for understanding climate impacts.
- Assimilative and nested models can fill gaps in observations and provide forecasts for decision-making.

Ocean Acidification and Hypoxia

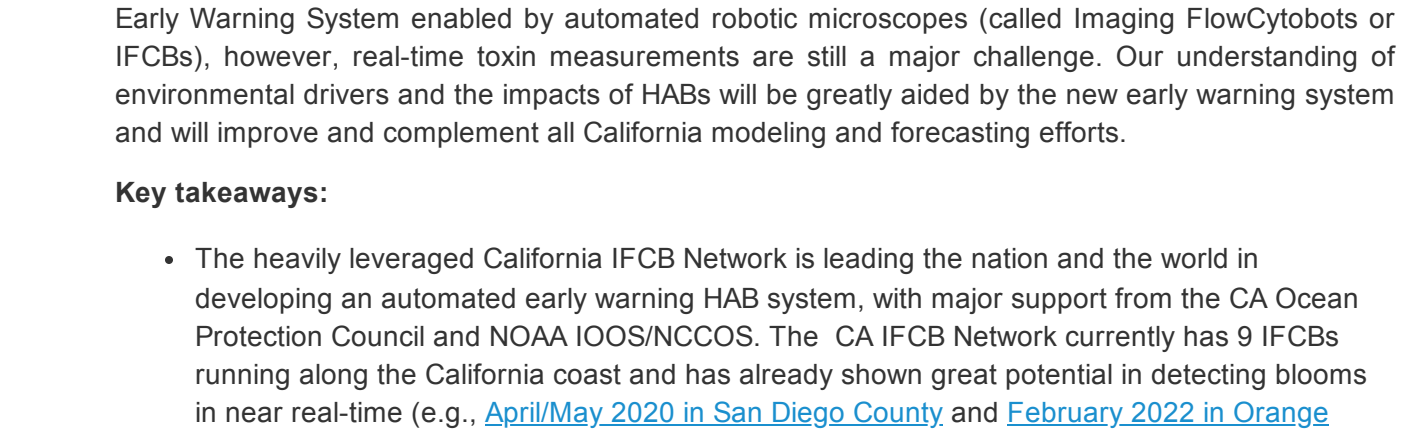
Upper panel left: SCCOOS PI Todd Martz, UCSD SIO, highlights new Self-Calibrating SeaPHox deployment at Scripps Pier and future deployments at Stearns Wharf and Santa Monica Pier in subsequent years and the great potential of historical pCO2 data on CalCOFI line 90.90 going back 40-years. Upper panel right: Yui Takeshita, MBARI, emphasizes the need for sustained co-located measurements in order to distinguish between natural and anthropogenic perturbation. Bottom: Jan Newton, NANOOS Executive Director, facilitating the OAH stakeholder discussion.

Assessment of OAH exposure and vulnerability is chastened by lacking long-term, high quality information, particularly in sub-surface and benthic environments. NOAA-supported moorings and periodic West Coast OA cruises provide "snapshots" of conditions, yet more widespread sampling is needed. Intercalibration across observing platforms and institutes can help ensure OAH data are climate quality. More work is needed to engage additional communities in OAH monitoring, which starts with communicating potential risks to marine resources.

Key takeaways:

- While a few key OAH datastreams exist, large spatial and temporal gaps in information make statewide analysis difficult.
- Concerns about data quality and interoperability further inhibit comprehensive assessment.
- Local scale studies of OAH dynamics and carbonate chemistry variability can help quantify important alongshore regimes and understand differences in nearshore environments.
- In order to deliver relevant information to stakeholders, additional effort is needed to communicate risks and mitigation strategies, including opportunities for Tribes and other local communities to engage in OAH observing.

Harmful Algal Blooms



Left: SCCOOS PI, David Caron, USC, comparing domoic acid in shellfish in Ventura and Santa Barbara Counties versus San Diego, Orange and Los Angeles Counties from Smith et al. 2018. Right: Jayme Smith, SCCWRP Scientist, facilitating the Harmful Algal Bloom stakeholder discussion session.

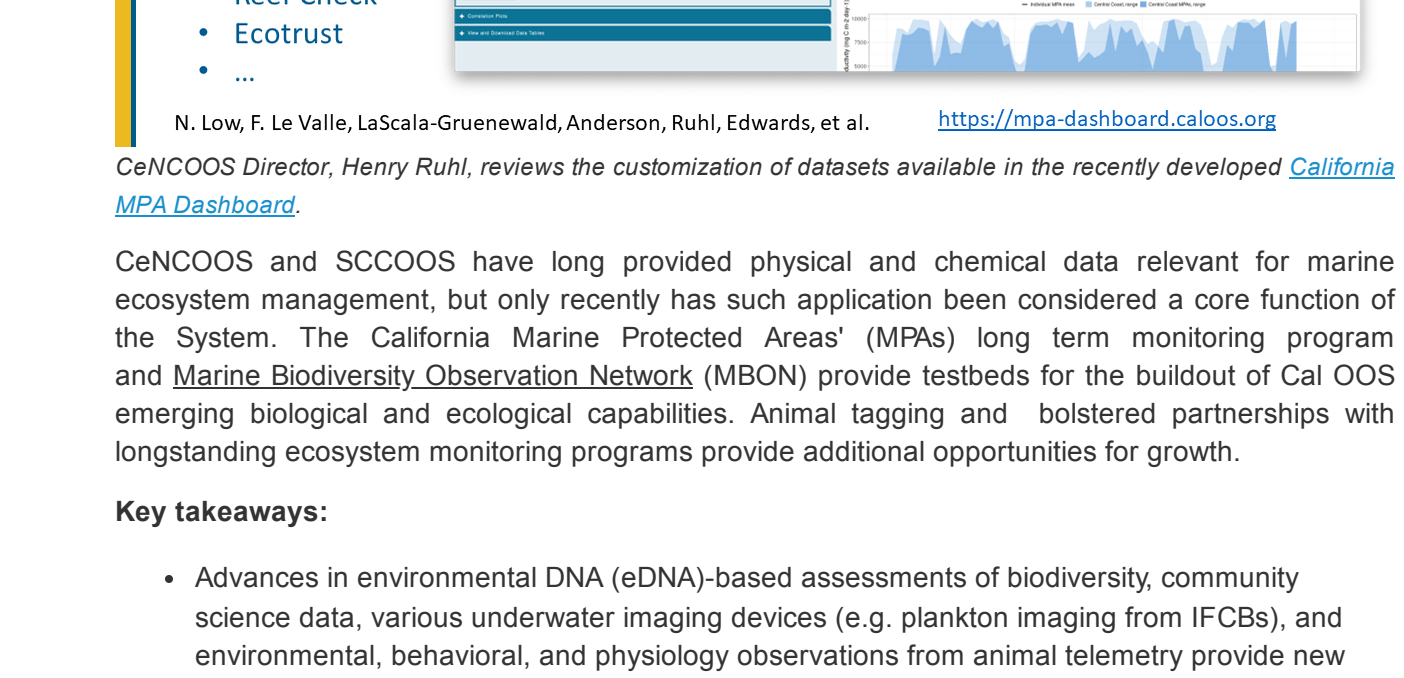
The Harmful Algal Bloom Monitoring and Alert System (HABMAP) is a hallmark of the CalOOS portfolio and the largest HAB monitoring investment across the IOOS enterprise. With weekly sampling of HAB taxa, toxins, and macronutrients that dates back to 2008 and even earlier at some sites, time series analysis to detect and understand trends in HABs is now possible. This analysis is revealing decadal and sub-decadal oscillations in dinoflagellate- vs. diatom-dominated communities and their associated HAB event. The CA HAB Bulletin is a monthly synthesis of HABMAP data, C-HARM forecasts for domoic acid, animals stranding data, fisheries closures, and State sampling that has been useful to the stakeholder California-wide community. A major project is underway to enhance the frequency and real-time delivery of HAB observations through implementation of a HAB Early Warning System enabled by automated robotic microscopes (called Imaging FlowCytobots or IFCBs), however, real-time toxin measurements are still a major challenge. Our understanding of environmental drivers and the impacts of HABs will be greatly aided by the new early warning system and will improve and complement all California modeling and forecasting efforts.

Key takeaways:

- The heavily leveraged California IFCB Network is leading the nation and the world in developing an automated early warning HAB system, with major support from the CA Ocean Protection Council and NOAA IOOS/NCCOS. The CA IFCB Network currently has 9 IFCBs running along the California coast and has already shown great potential in detecting blooms in near real-time (e.g., April/May 2020 in San Diego County and February 2022 in Orange County). Three more IFCBs purchased by our partners round out a 12-unit network. The data are available in near real-time on the IFCB dashboard. Automated classifiers coming soon.
- Potential new application for Solid Phase Adsorption Toxin Tracking (SPATT) to detect predator information from trace concentrations of copepodamides will allow real-time tracking of grazer feedbacks with HABs (Kudela Lab)
- Sea Lion strandings from DA toxicosis are reported in the CA HAB Bulletin, and a major analysis of DA events and marine mammal impacts is revealing new patterns (Smith et al. 2021).
- Trinidad was shown to be a new and persistent Domoic Acid hotspot since the 2015-2016 marine heat wave, with particulate levels exceeding 100,000 ng/L (Kudela, Anderson, Bjorkstedt collaboration, Trainer et al. 2020) and recurring closures of Dungeness crab and razor clam fisheries. Warmer conditions may lead to earlier and longer dinoflagellate-dominated periods and potential HABs (Barth et al. 2020, Fischer et al. 2020)
- Molecular methods better capture phytoplankton community composition compared to traditional microscopy (Hammond et al. 2022 in prep)
- Stable isotope approaches (e.g. CSIA-Amino Acids) show potential for understanding DA transfer in the food web (Bernstein et al. 2021, Ruiz et al. in prep).

Modeling and process studies are putting observations to good use via mechanistic and trait-based approaches to understanding HAB dynamics and food web impacts.

Biology and Ecosystems



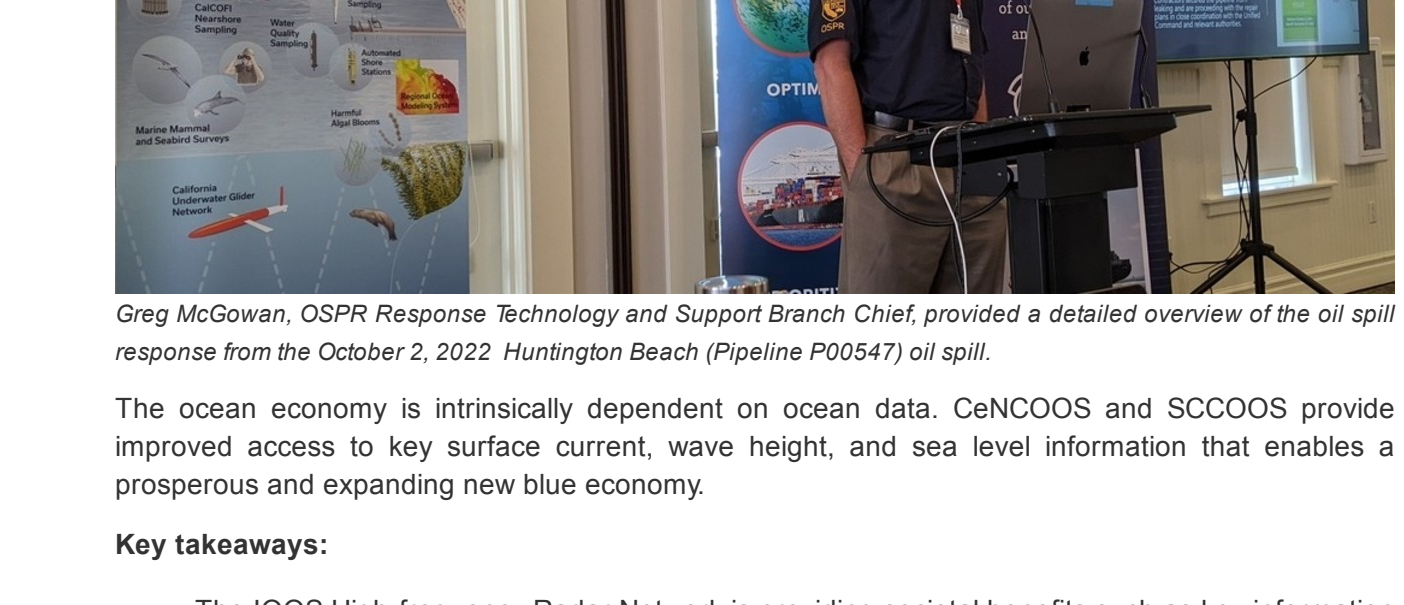
CeNCOOS Director, Henry Ruhl, reviews the customization of datasets available in the recently developed California MPA Dashboard.

CeNCOOS and SCCOOS have long provided physical and chemical data relevant for marine ecosystem management, but only recently has such application been considered a core function of the System. The California Marine Protected Areas' (MPAs) long term monitoring program and Marine Biodiversity Observation Network (MBON) provide testbeds for the buildout of Cal OOS emerging biological and ecological capabilities. Animal tagging and bolstered partnerships with longstanding ecosystem monitoring programs provide additional opportunities for growth.

Key takeaways:

- Advances in environmental DNA (eDNA)-based assessments of biodiversity, community science data, various underwater imaging devices (e.g. plankton imaging from IFCBs), and environmental, behavioral, and physiology observations from animal telemetry provide new opportunities to address multiple requirements for reporting status and trends.
- The Global Ocean Observing System (GOOS) Biology and Ecosystems Panel, the MBON, the Ocean Biomolecular Observation Network (OBON) and other efforts facilitate advancing this to meet needs for initiatives such as Marine Protected Areas and National Marine Sanctuary Condition Reports and the California Current Integrated Ecosystem Assessment (CCIEA).
- New indicators for statewide kelp and the Multivariate Ocean Climate Index (MOCI).
- Animal telemetry can offer a wealth of oceanographic data and inform on local challenges such as the presence and patterns of great white sharks along beaches where they can interact with people.
- Cyberinfrastructure tools are advancing to deal with data more efficiently and for a broader set of users. This includes the work of CalCOFI.io and FathomNet.org and more.

California's New Blue Economy



Greg McGowan, OSPR Response Technology and Support Branch Chief, provided a detailed overview of the oil spill response from the October 2, 2022 Huntington Beach (Pipeline P00547) oil spill.

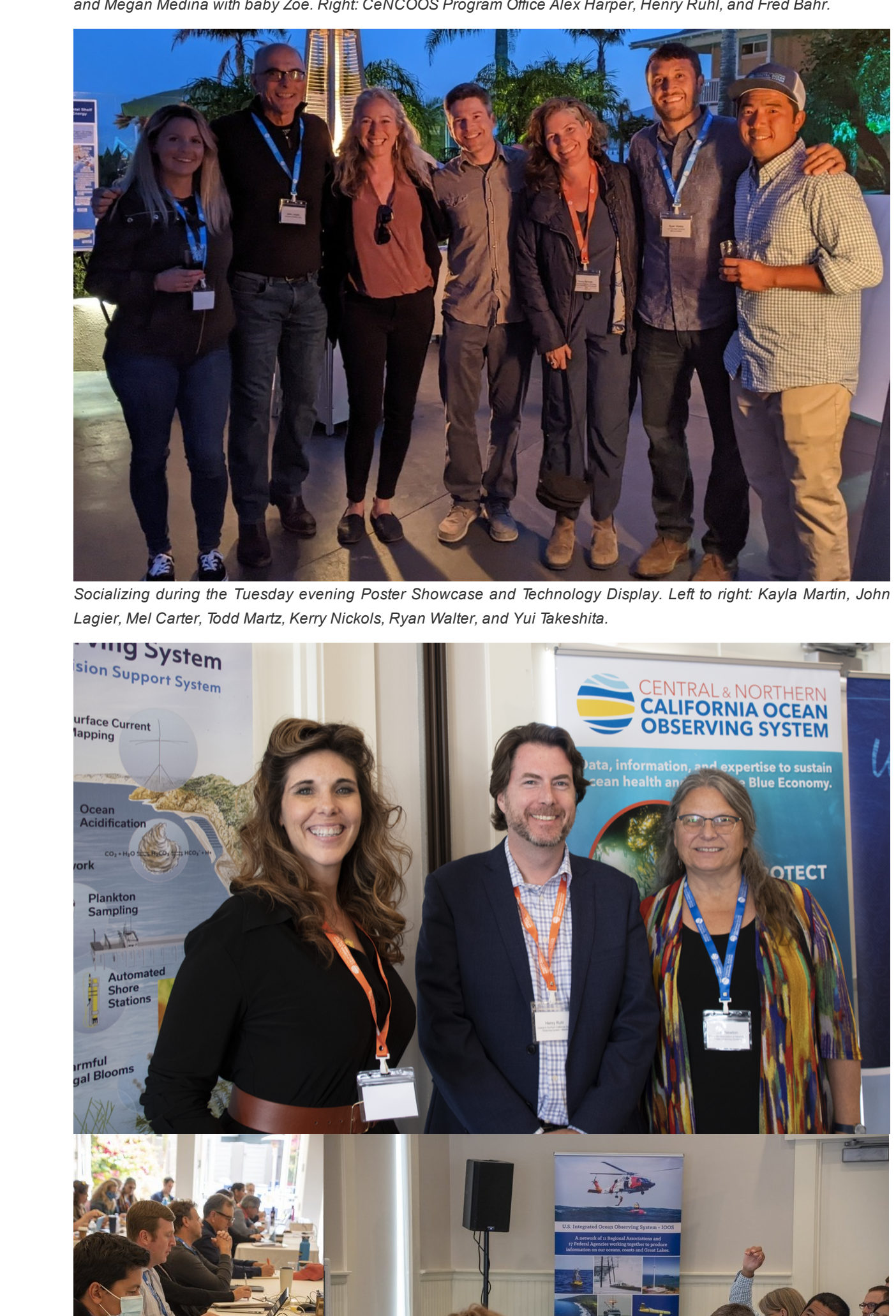
The ocean economy is intrinsically dependent on ocean data. CeNCOOS and SCCOOS provide improved access to key surface current, wave height, and sea level information that enables a prosperous and expanding new blue economy.

Key takeaways:

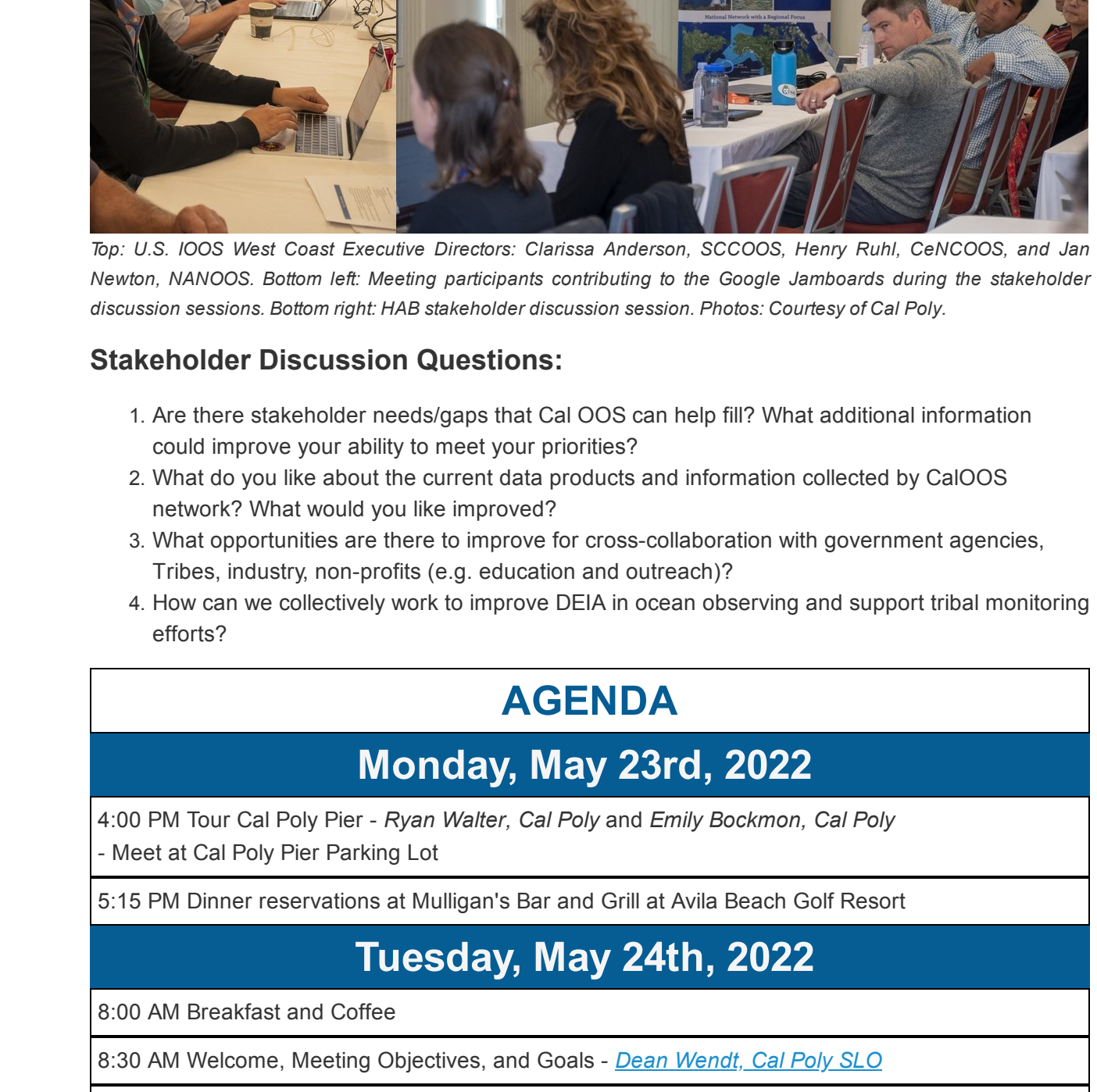
- The IOOS High-frequency Radar Network is providing societal benefits such as key information during oil spills.
- Shipping navigation and transport interact with whales and sea turtles.
- Immense opportunities and challenges accompany offshore wind development.

Poster Display and Technology Showcase

Left: SCCOOS Program Office and Leadership Clarissa Anderson, Libe Washburn, Dan Rudnick, Ross Timmerman, and Megan Medina with baby Zoe. Right: CeNCOOS Program Office Alex Harper, Henry Ruhl, and Fred Bahr.



Socializing during the Tuesday evening Poster Showcase and Technology Display. Left to right: Kayla Martin, John Lagier, Mel Carter, Todd Martz, Kerry Nickols, Ryan Walter, and Yui Takeshita.



Top: U.S. IOOS West Coast Executive Directors: Clarissa Anderson, SCCOOS, Henry Ruhl, CeNCOOS, and Jan Newton, NANOOS. Bottom left: Meeting participants contributing to the Google Jamboards during the stakeholder discussion sessions. Bottom right: HAB stakeholder discussion session. Photos: Courtesy of Cal Poly.

Stakeholder Discussion Questions:

1. Are there stakeholder needs/gaps that Cal OOS can help fill? What additional information could improve your ability to meet your priorities?
2. What do you like about the current data products and information collected by CalOOS network? What would you like improved?
3. What opportunities are there to improve for cross-collaboration with government agencies, Tribes, industry, non-profits (e.g. education and outreach)?
4. How can we collectively work to improve DEIA in ocean observing and support tribal monitoring efforts?

AGENDA

Monday, May 23rd, 2022

4:00 PM Tour Cal Poly Pier - *Ryan Walter, Cal Poly and Emily Bockmon, Cal Poly* - Meet at Cal Poly Parking Lot

5:15 PM Dinner reservations at Mulligan's Bar and Grill at Avila Beach Golf Resort

Tuesday, May 24th, 2022

8:00 AM Breakfast and Coffee

8:30 AM Welcome, Meeting Objectives, and Goals - *Dean Wendt, Cal Poly SLO*

8:40 AM Legislative Update - *Josie Quintrell, IOOS Association*

8:50 AM IOOS Update - *Brian Zelenke, IOOS*

9:10 AM SCCOOS FY21-26 Proposal Summary and Future Vision - *Clarissa Anderson, SIO/SCCOOS*

9:30 AM CeNCOOS FY21-26 Proposal Summary and Future Vision - *Henry Ruhl, MBARI/CeNCOOS*

9:50 AM Cal OOS Data Portal - *Rob Bochenek, Axiom Data Science*

10:15 AM Break

Climate Variability and Change

10:30 AM Scientific Presentations

- Southern California Bight Climate Trends - *Dan Rudnick, SIO*
- Central and Northern Climate Trends - *Jack Barth, OSU* (virtual)
- Ecosystem Moorings - *Francisco Chavez, MBARI*
- COMT/WCOFS - *Chris Edwards, UCSC* (virtual)

11:30 AM Stakeholder Discussion Climate Variability and Change Jamboard - Facilitator *Corey Garza, CSUMB/SACNA*

12:00 PM Lunch Catered

Ocean Acidification and Hypoxia

1:00 PM Scientific Presentations

- Northern California - *John Largier, UC Davis*
- Central Coast - *Emily Bockmon, Cal Poly SLO*
- Southern California Bight - *Todd Martz, SIO*
- BioEco Gliders and THOOS - *Yui Takeshita, MBARI*

2:00 PM Stakeholder Discussion OAH Jamboard - Facilitator *Jan Newton, NANOOS*

2:30 PM Snack Break

Harmful Algal Blooms

2:45 PM Scientific Presentations

- California's North Coast - *Kendra Negrey UCSC*
- Central California - *Ally Pasulka, Cal Poly*
- Southern California Bight - *Dave Caron, USC*
- CA IFCB Network - *Clarissa Anderson, SIO/SCCOOS*

3:45 PM Stakeholder Discussion HAB Jamboard - Facilitator *Jayme Smith, SCCWRP*

4:30 PM PM Adjourn

6 PM Cocktail Hour on the Sundeck with Poster Visits and Technology Showcase - Hosted by SCCOOS and CeNCOOS and Sponsored by CODAR and Axiom Data Science!

- Alex Harper, CeNCOOS/MBARO - California OAH Coastal Obs Network
- Corey Garza, CSUMB - Drone display
- Faycal Kessouri, SCCWRP - Regional Monitoring supports numerical modeling in the Southern California Bight
- Holly Bowers, SJSU - qPCR Machine display
- James Behrens, CDIP - Coastal Data Information Program: Measuring, Modeling, and Forecasting Waves on the California Coast
- Jayme Smith, SCCWRP - Linking Regional Monitoring Observations to Domoic Acid Related Marine Mammal Strandings Events in Southern California
- Kasia Kenitz/Clarissa Anderson, SIO - CA IFCB Network
- Kayla Marin, SIO
- Lindsey Peavey, NOAA - SancSound Web Portal
- Marisol Garcia Reyes, FI - Multivariate Ocean Climate Indicator
- Susan Zaleski, BOEM
- Tom Connolly, SJSU - Observations of nutrient variability in nearshore and estuarine waters of central Monterey Bay

Wednesday, May 25th, 2022

8:00 AM Breakfast and Coffee

8:30 AM Review Day 1 and Goals for Day 2

Biodiversity Ecosystem and Health

8:45 AM Scientific Presentations

- Marine Protected Areas - *Henry Ruhl, CeNCOOS*
- Marine Biodiversity Observation Network - *Francisco Chavez, MBARI*
- Animal Telemetry Network - *Chris Lowe, CSU Long Beach*
- CalCOFI Data Synthesis and Dashboard - *Erin Satterthwaite, SIO*

10:00 AM Stakeholder Discussion Biodiversity and Ecosystem Health Jamboard - Facilitator *Andrew DeVogelare, MBNMS*

10:30 AM Snack Break

California's New Blue Economy:
Coastal Resilience, Navigation, and Commerce

10:45 AM Scientific Presentations

- California Coastal Flood Network - *Mark Merrifield, SIO* (virtual)
- Huntington Beach Oil Spill Response Efforts - *Greg McGowan, OSPR*
- Offshore Renewable Energy - *Susan Zaleski, BOEM*
- National HFR - *Brian Zelenke, IOOS*

11:45 AM Stakeholder Discussion California New Blue Economy Jamboard - Facilitator *Susan Zaleski, BOEM*

12:15 PM Meeting Overview and Next Steps

12:45 PM Lunch Catered

2:00 PM Adjourn

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