

ecosystem models, and 4) utilize data to create products to inform policy and decision-making. Progress on each of these strategies is enabled by the substantial contributions made by partners that contribute, time, effort, observing assets, and resources towards common goals, quadrupling the investment made by this project, and engaging invaluable scientific skill and expertise. Beyond the value of the observations and forecasts and value of the archived data that can be re-used for other purposes, the observing systems also serve as a technology-incubator, as a resource promoting STEM education (science, technology, engineering, and math) and U.S. technology leadership, and as a knowledge-base for wise stewardship of our nation's coastal resources.

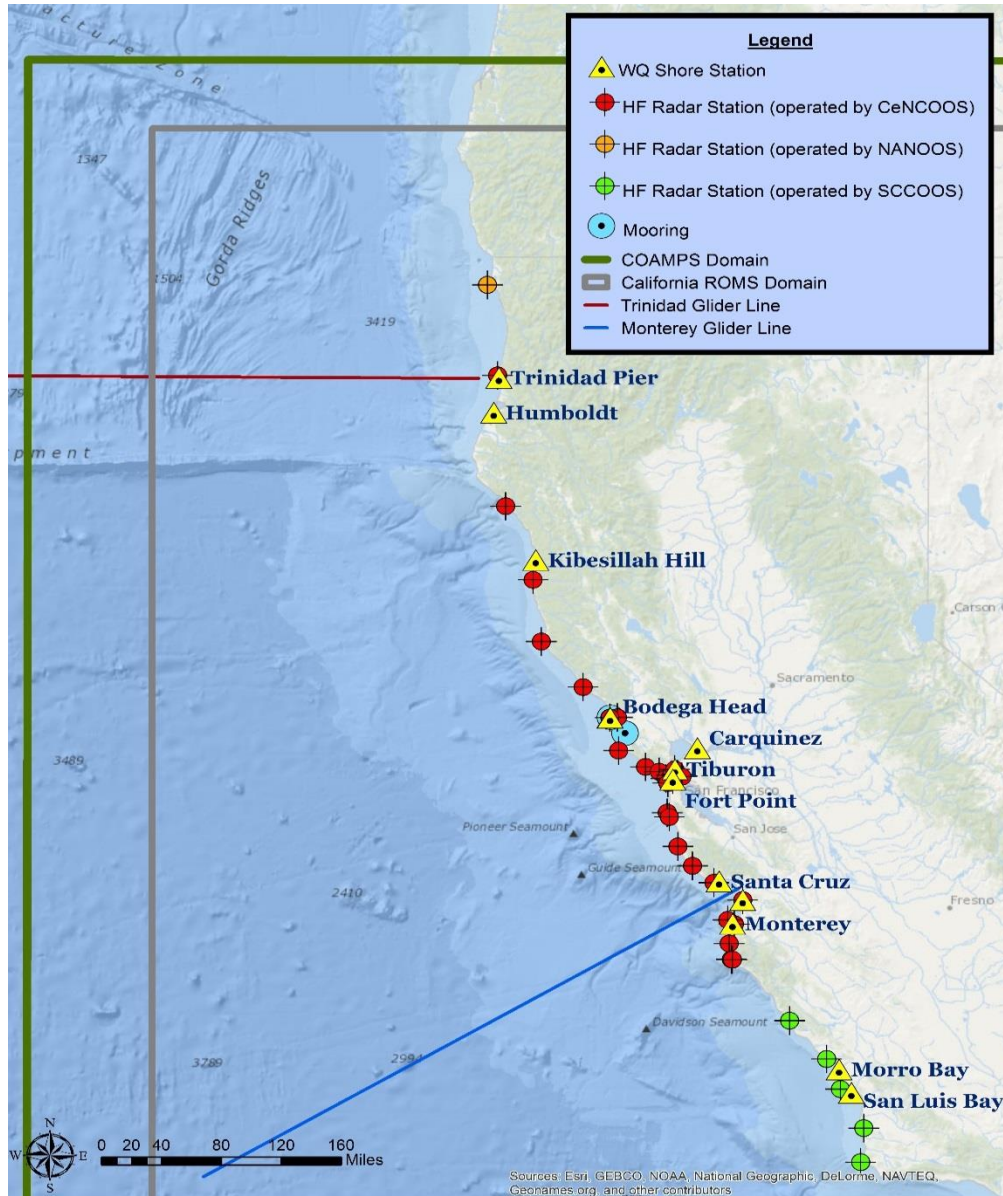


Figure 1: CeNCOOS Supported Observing Assets as of Dec 2016

2) Progress and Accomplishments

A) Governance

Milestone Reporting:

- 1) Coordinate observing systems, host two meetings per year; Continuing
Status: On track - The second meeting is scheduled for Spring/Summer 2017.
- 2) Coordination (IOOS, IOOSA, MTS, AGU, Hill, CA govt) ; Continuing
Status: On track - The CeNCOOS program office has participated in IOOS, IOOSA, and MTS coordination meetings and events during this reporting period, and we continue to coordinate our observing and data efforts with the State of California. We also had several PIs contribute to AGU.
- 3) Manage projects, receive, disburse, oversee funds (semi-annual reporting); Continuing
Status: On track - MBARI and CeNCOOS staff continue to administer the program.
- 4) Facilitate partnerships including grant writing; Original completion date: May 2016
Status: On track – CeNCOOS continues to facilitate and strengthen partnerships in the region to leverage the IOOS funding we receive and to better meet the needs of stakeholders. Examples from this reporting period include working with citizen science groups that collect marine mammal stranding data to integrate their databases into the CeNCOOS data portal, and working on the management of ROV video data with the State of California (both of these projects we expect to complete within the next reporting period).

Additional Notes:

- The CeNCOOS program manager and information manager worked with shellfish growers in the Humboldt region to evaluate and update the “Humboldt Oyster Conditions” dashboard. We developed this page in 2014 to aggregate information useful to growers in the area into one location, thus making it easier for them to access and use the data being collected to manage their crop. The updated page adds additional parameters and an additional monitoring location (Indian Island). The dashboard can be found at: <http://www.cencoos.org/data/humboldt/indian-island-oyster>
- CeNCOOS staff, and in particular the CeNCOOS product developer, have been working with the National Marine Sanctuaries in the region to develop products that will better inform their “Sanctuary Conditions” reports. The product developer has created python notebooks for data plots and generated “clean” datasets and developed climatologies for relevant observing assets (and satellite data sets). Products from these efforts will be made publically available by the end of the fiscal year.

B) Observing

Milestone Reporting:

- 1) Operate 27 HF radar; Continuing
Status: On track – CeNCOOS PIs (UC Davis, CODAR, NPS) continue to operate the 27 HF radars in the region. Uptime for the system was relatively high for this reporting period (UC Davis report 92% uptime).

Additional HFR notes:

- UC Davis restored power to Point Bonita, replaced equipment, and resumed operations. Planned upgrades were made to enclosures and remote power control for all sites operating with inadequate options. They also performed extensive beta testing of CODAR Radial Suite Release 10 Update 8.
- Pescadero Point and Point Sur Long Range had equipment transitions at the beginning of the reporting period that produced gaps and suspect data. The systems were run for a week or so adjusting the settings until the data looked good again, but gaps were produced in the beginnings of those 2 timelines
- The Treasure Island HFR site has been decommissioned. We have found and tested a replacement site near Point Richmond but have not yet obtained permits. We expect to install the new HFR near Point Richmond in February 2017.
- The Moss Landing HFR was vandalized in 2016 creating a gap in a non-priority site. We anticipate that CeNCOOS supported operator NPS will repair the vandalized site in January 2017.
- The new communication systems installed by CODAR Ocean Sensors in the NPS region, coupled with the upgraded computers, served to greatly increase reliability and real time data availability during this period.

2) Operate 13+ shore stations; Continuing

Status: On track – CeNCOOS continues to support the operation of 13 automated shore stations in the region.

Additional HFR notes:

- With the help of the Wiyot Tribe, in February 2016, the Indian Island Station's datalogger (purchased by CeNCOOS), was installed and brought online and integrated with the CeNCOOS Shore station website. Unfortunately, in July of 2016, the datalogger failed at the station. The datalogger was sent back to the manufacturer, and after several months of back and forth with YSI, the electronics were replaced, and the unit was returned. The station was finally reinstalled successfully and brought back on-line 10/11/16, and the data is now streaming data.
- HSU and CeNCOOS have been assisting the Tolowa Dee-ni' Nation (formerly Smith River Rancheria) to develop a station at the Smith River. They received funding from the Bureau of Indian Affairs for their instruments and are in the process of developing the infrastructure to support them. Deployment is anticipated for summer 2017.
- In July, the lead PI on the HSU CeNCOOS project was transferred from Dr. Frank Shaughnessy to Dr. Brian Tissot, the director of the HSU Telonicher Marine Lab.
- SFSU continues to work with UCD to deploy a CO2 monitoring buoy just off of the Romberg Tiburon Center. EPA/San Francisco Estuary Partnership (SFEP) funding became available (and contracts signed) as of 8/1/2016. They are actively pursuing the required permits to deploy the instrument.
- The data went offline at the Santa Cruz station because of problems with YSI ECONET service. The pump went down November 16 and is being repaired. We anticipate this station coming back on line in February 2017.

- The Monterey Wharf station began experiencing problems earlier this year due to heavy swells damaging the existing mounting system. The asset was redeployed with a new, reinforced mounting bracket on September 9; however the asset's telemetry was lost on September 13 due to YSI discontinuing their ECONET service. Since that time, they have been manually downloading the data monthly. CeNCOOS is working with MLML to address this issue, which should be resolved in February 2017.
- MLML has been testing a pCO₂ sensor at the lab's shore station. The initial deployment showed a need to reset the range of the sensor to account for higher than expected pCO₂ values during summer months. After this modification, they will serve the real-time data publically (likely beginning in February 2017. Data from the initial deployment is available upon request.
- R. Walter (Cal Poly) is currently investing the decline of eelgrass in Morro Bay with other scientists, the Morro Bay National Estuary Program, and CDFW. He successfully deployed supplemental instruments this past summer to look at the relationship between hydrodynamics and water quality data for future restoration efforts. The CeNCOOS measurements are being used in this ongoing analysis.

3) Operate 2 glider lines; Continuing

Status: On track – CeNCOOS continues to support 2 glider lines in the region; one on CalCOFI line 66.7 (a collaboration between MBARI, the California Underwater Glider Network, and the Scripps Institution of Oceanography) and one off Trinidad head (a collaboration between OSU and NANOOS).

Additional glider notes:

- In addition CeNCOOS funds have supported MBARI with: a) periodic deployment of two NPS Spray gliders with environmental sensors and the collection of background/animal sound information; b) development and application of ocean acidification payloads on Liquid Robotics wave gliders; c) deployment of two UC Santa Cruz Webb-Teledyne gliders in support of harmful algal bloom studies; d) deployment of small coastal moorings with ocean acidification (T, S, CO₂, pH, nitrate, oxygen, fluorescence) sensors and a hydrophone to listen for tagged animals (in collaboration with TOPP scientists); e) processing of information from a-d and making it available to CeNCOOS. The data and products developed are used extensively by a wide variety of end users including modelers, scientists, students, and managers (sanctuaries, etc.).
- For the reporting period 6/1/2016 to 11/30/2016 the Trinidad glider was on the line for 184 days during two deployments, sampled along nearly 3307 km of track line covering the transect about 6 times, and collected about 1486 vertical profiles of ocean properties. The glider "uptime" was 99%. Data are being sent in near real-time to the IOOS Data Acquisition Center and, simultaneously, to the CeNCOOS and NANOOS data centers.

4) Expand monitoring SF Bay, contribute to annual bay collaborative meeting; Original completion date: Year 1, quarter 3 (winter 2017)

Status: On track – CeNCOOS program office staff were unable to attend the annual Bay

Collaborative meeting this year due to a conflict with the annual IOOSA meeting, but several CeNCOOS PIs attended and represented the organization. We anticipate significantly increasing the data we serve in San Francisco Bay next quarter (adding 3-5 water quality monitoring sites and a Bay circulation model to the CeNCOOS data portal). We also anticipate the deployment and serving of data from IFCB transect cruises (UCSC/SFEI/USGS project supported by OTT) and the deployment of a PCO2 buoy by SFSU by May 2017).

Additional Notes:

- CeNCOOS also support weekly harmful algal bloom monitoring at three sites as part of the CalHABMAP program: Santa Cruz wharf, Monterey wharf, and Cal Poly pier). Additionally, with support from CeNCOOS UCSC has continued to analyze toxin samples for participants in the region. During this interval, in particular, they expanded sampling to include Humboldt State University/SFWSC (Trinidad Head line) a CalCOFI cruise, and the Santa Barbara LTER site. They also processed samples for City of Santa Cruz, and Debra Iglesias' lab at UC Santa Barbara. Given the large bloom in 2015 and ongoing questions about Dungeness Crab, the data and analysis have been included in multiple presentations, reports, and testimony for the California Fisheries Commission.

C) Data

Milestone Reporting:

- 1) Acquire real time obs (HFR, shore, glider, model); Continuing
Status: On track – CeNCOOS intends to integrate 10 new datasets this fiscal year. Much of this work was not completed during this reporting period due to the work on the new data portal GUI and the loss of the CeNCOOS Information Manager, however we are on track to reach this benchmark by the end of the fiscal year.
- 2) Perform QC, including QARTOD; Continuing
Status: On track – CeNCOOS continues to perform existing QC on sites.
- 3) Maintain & export catalog; Continuing
Status: Axiom continues to maintain the CeNCOOS data catalog and link it to the national data infrastructure. CeNCOOS now has 184 entries in the IOOS Catalog.
- 4) Web services incl. ERDDAP, THREDDS; Continuing
Status: Axiom also continues to maintain and update the CeNCOOS ERDDAP, THREDDS, and i52n-sos deployments and maintain data harvesting systems for incoming model, forecast, and in-situ sensor data streams.
- 5) Archive data at repositories; Continuing
Status: On track - Axiom staff enhanced and improved a system to submit sensor data to NDBC for archival and discovery. Staff worked with contacts at NDBC to submit and validate data, and CeNCOOS sensor data streams are now flowing from Axiom's systems to NDBC. Axiom staff are also finalizing a submission system to archive sensor data to NCEI. The system is currently operational, and Axiom staff are in active communication with NCEI staff to fine tune technical details of this system.

- 6) RICE certification; Original completion date: May 2017
Status: On Track. We planned to submit this application in August but have not yet completed the application because the documentation of data streams is a larger task than anticipated. We hope to submit the application in early 2017. A potential additional delay may be encountered if we are unable to resolve our liability for CeNCOOS governors.
- 7) Maintain portal, continue integrating data; Continuing
Status: On track – The current portal is fully operational. The DMAC team continues to develop and enhance the next generation portal interface that CeNCOOS will be transitioning to over the next six months to a year. Work during this reporting period includes enhancement of a prototype viewer and integrated mapping layer for glider data sets. The new tool enables glider trajectory data streams to be visualized as curtain plots, two dimensional maps and three dimensional WebGL HTML5 visualizations.

Additional Notes:

- The CeNCOOS data system experienced an uptime of 99.9% or (~100%). Data ingestion occurred during the entire reporting period and approximately 7 TBs of numerical modeling and observational data were imported into the system.

D) Modeling & analysis

Milestone Reporting:

- 1) Provide boundary conditions; Continuing
Status: On track – CeNCOOS continues to support the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) run by NRL. These atmospheric forecasts are used to force real-time ocean circulation models including the Navy Coastal Ocean Model (NCOM) and the Regional Ocean Modeling System (ROMS), which are executed by multiple institutions in the government laboratory and university communities.
- 2) Operate 2 ROMS; Continuing
Status: On track - CeNCOOS continues to support UCLA to maintain a real-time nowcast/forecast system using the 3-km California state-wide ROMS model with data assimilation capabilities, and the UCSC Ocean Modeling Group to produce state estimates for the California Current System using an advanced 4-Dimensional Variational data assimilation approach. The model outputs are provided to CeNCOOS and can be directly accessed from the CeNCOOS web site.

Additional Notes:

- In the past year, a fully coupled (air-ocean) COAMPS model configuration continues to be tested in real time in a quasi-operational mode to provide more consistent air-sea fluxes leveraging FNMOC computational resources. The COAMPS 36, 12, 4 km meshes are tightly coupled with an NCOC 4 km mesh in the current configuration. FNMOC and NRL are currently working on ocean verification for the coupled domain. NRL and FNMOC are currently discussing the details of possibly implementing this system in the Navy operational suite.

- COAMPS accurately forecasted surface winds on 1800 UTC 15 October 2016. The intensity and timing of front approaching Northern California is predicted very well comparing with the NOAA GFS analysis (Figure 1). The forecast of this strong winds event is also verified by the surface station observation and satellite data (Figure 2).

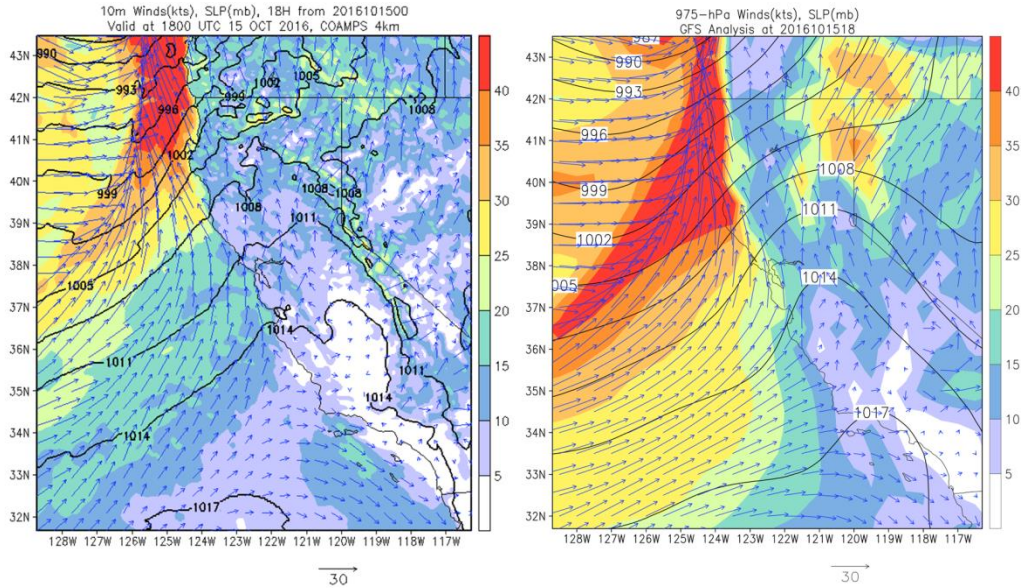


Figure 1. (a) The 10-m winds (kt, shaded and vectors) and sea level pressure (hPa, contoured at 3 hPa intervals) from 18-h COAMPS forecast, and (b) the 975-mb winds (kt, shaded and vectors) and SLP (hPa, contoured at 3 hPa intervals) from GFS analysis at 1800 UTC 15 Oct. 2016.

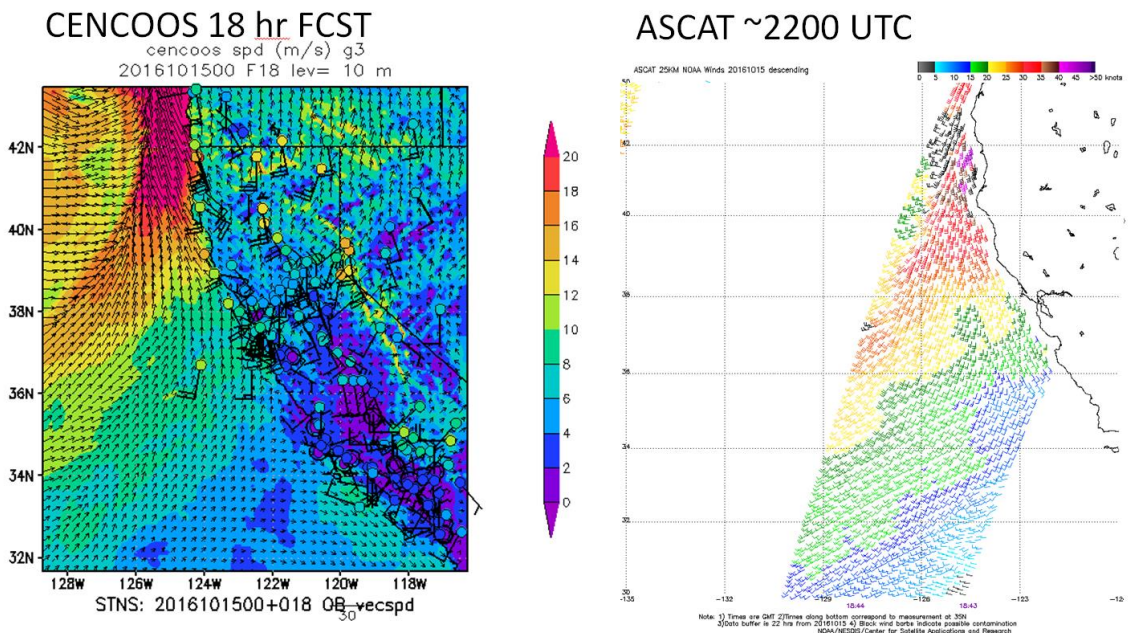


Figure 2. (a) The 10-m winds of 18-h COAMPS forecast, is compared to (b) the ASCAT winds at 2200 UTC 15 Oct. 2016.

- From June 1, 2016 to November 30, 2016, UCSC (a) updated the data sets assimilated into their near-realtime 4DVar Data Assimilation System (they now assimilate TS data from glider lines available through IOOS and surface velocity data from the HF radar network), (b) performed a new physical reanalysis extending from 2011 to the present, (c) modified our procedure to serve model output on z-levels instead of the ROMS terrain-following grid.
- Considerable progress was also made by UCSC on implementing the 11-component NEMRUO biogeochemical model as an improvement over the previous 4-component NPZD model. The model change is beneficial because NEMRUO includes two phytoplankton functional groups representing fast growing diatoms that dominate in nutrient-rich coastal upwelling conditions and smaller nanophytoplankton that thrive in more nutrient limited waters. The challenge of assimilating satellite chlorophyll, which represents the sum total of all phytoplankton chlorophyll into a model with two phytoplankton components was overcome.
- UCLA has been providing their ROMS output to the Office of Protected Resources within NOAA Fisheries in order to predict the drifting trajectory of a dead whale known as Wally. The 22-ton, 45-foot-long carcass was first found on Dockweiler State Beach in Los Angeles County on June 30. Lifeguards tugged it back to the ocean, but it reappeared further south, twice being towed after floating close to Newport Beach and then again when it got too close to Dana Point and San Clemente. You can find related reports on this event at:
<http://www.ocregister.com/articles/whale-722813-wally-washed.html>

E) Education and Outreach

Milestone Reporting:

- 1) Develop materials including newsletter, weekly social media presence; Continuing
Status: Delayed – CeNCOOS maintained the anticipated effort towards this milestone until the CeNCOOS Information Manager moved on to a new position in September 2016. The loss of capacity has made it difficult to complete our social media and other written material goals. We anticipate getting back on schedule within the next reporting period following the re-hire of the position.
- 2) MBARI Open house and tables or booths at regional meetings; Original completion date: May 2017
Status: On Track. We operated a CeNCOOS booth at several regional meetings and events, including the annual MBARI open house, attended by over 1,000 people. CeNCOOS also had a presence at the Western Society of Naturalist meeting and the Monterey Area Research Institutions' Network for Education Research Symposium (amongst others).
- 3) Develop tutorial on using IOOS data and present at MTS/Oceans in Monterey; Original completion date: Year 1, quarter 2 (fall 2017)
Status: Delayed. The tutorial was cancelled because of insufficient enrollment, however the materials that were prepared will be used for a tutorial at a future meeting. We

determined that more advertising and an option for students to participate at a reduced rate are needed to meet our attendance goals.

- 4) Support IOOS office and eleven RA's at MTS/Oceans meeting in Monterey; Original completion date: Year 1, quarter 2 (fall 2017)
Status: Completed September 23, 2016. In addition we organized a photo opportunity at the Monterey Abalone Company and the Monterey CeNCOOS shore station.

2) Scope of Work

No Changes.

3) Personnel and Organizational Structure

Information Manager Jennifer Patterson resigned Sept. 21, 2016. We intend to fill the position, but have not done so as of the end of the period. CeNCOOS Director David Anderson will resign on January 31, 2017. The Governing Council met December 6 and determined that Francisco Chavez will become Acting Director on February 1, 2017. The Governing Council Executive Committee will oversee the search for a new Director. No changes to the Governing Council were made.

4) Budget Analysis

The year 1 award amount was \$2,403,562, plus \$60,000 that was delivered directly to NPS for HFR and \$42,000 delivered directly to NRL for modeling. The award amount included \$110,000 to CODAR for the operation of a national spare parts project and \$200,000 to CODAR for a Tsunami project, and \$23,000 for MBON travel by F. Chavez. The year 1 amount was de-scoped from the original \$4M request. As directed at least \$623,000 will be spent on HFR operation and maintenance. \$1,498,516 was distributed to ten institutions as sub-awards. All sub-awards continue the observing, modeling, data management, analysis, and education and outreach activities that were supported by the previous award. Indirect costs associated with the creation of the sub-awards decreased the amount available to the investigators in this first year by 10-20% however in all cases the investigators were able to maintain the previous activities. The one-year \$30k reduction in DMAC support was discussed with our IOOS point of contact J. Rhoades. The Cal Poly sub-award will be augmented by \$13,520 to purchase a Seabird 19+ profiling CTD using the shore station supplies budgeted in the proposal. No capital purchases were made by the host institution. We project an end of year balance of \$35,378.