

California Marine Protected Area Marine Monitor (M2) Radar Project

Progress Report for the Morgan Family Foundation

Prepared by

NOAA Channel Islands National Marine Sanctuary and the California Marine Sanctuary Foundation

November 2018



Photos of the Santa Cruz Island M2 site monitoring Channel Islands National Marine Sanctuary and National Park

Executive Summary

This progress report provides an overview of the activities completed and underway related to the management and validation of the Marine Monitor (M2) remote sensing systems coordinated by NOAA Channel Islands National Marine Sanctuary and the California Marine Sanctuary Foundation staff in three locations within California.

The three established sites at Piedras Blancas, Coal Oil Point, and Santa Cruz Island have been operational and collecting historical data since July 2018 – with over 40,000 tracks recorded in total since installation. Plans to enhance the current sites through the addition of camera systems and to establish a new site at Anacapa Island are underway. Management of these sites during this phase has been focused on two main objectives: 1) coordinating activities across all established M2 sites within the state to share information and disseminate lessons learned and 2) validating the output of the M2 data to ensure the quality of information communicated to state and federal resource management agency partners.

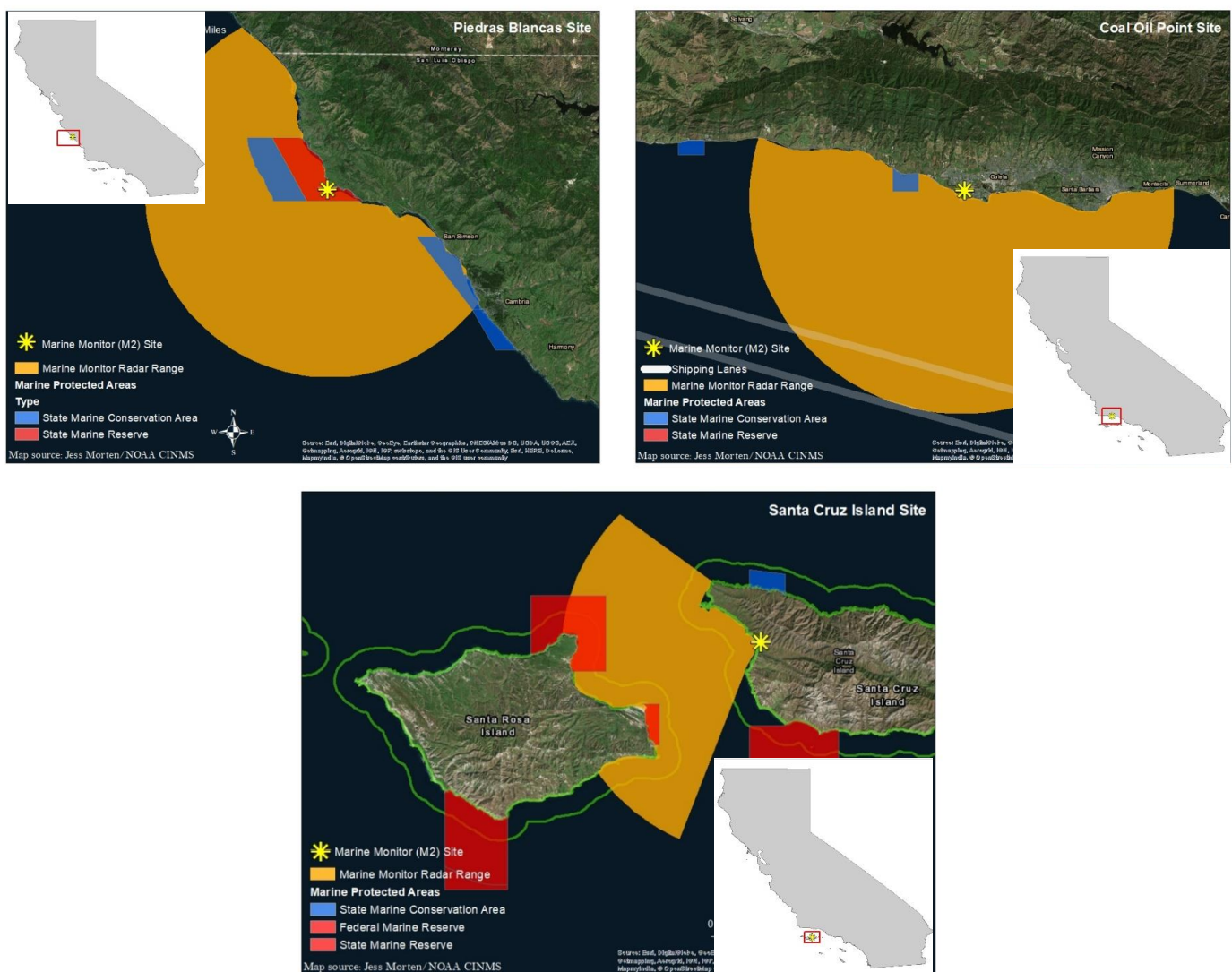
In total, 31,380 tracks* were recorded by the M2 receivers across the three sites from July 1 through October 31, 2018, with 14,749 occurring around the Coal Oil Point M2 site, 8,950 tracks occurring off of the Santa Cruz Island site, and 7,747 tracks recorded off of the Piedras Blancas site.

***Note:** individual vessel tracks do not necessarily indicate unique vessels and total number of tracks is not indicative of total number of vessels. Given the technological limitations of the radar hardware, a single vessel may produce multiple tracks.

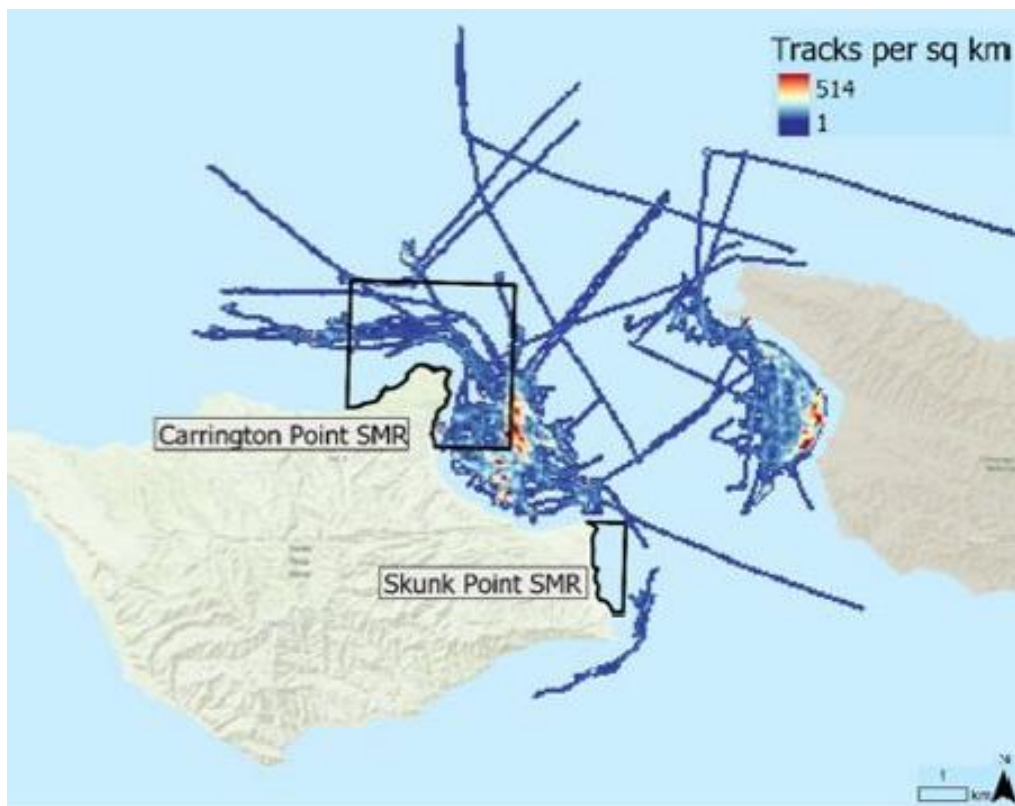
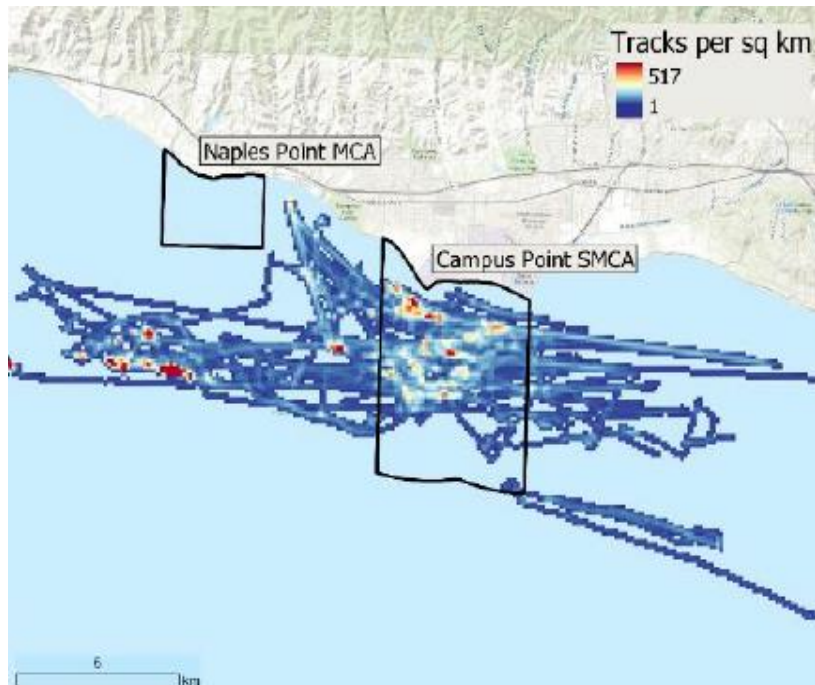
Project Background

California's 840 miles of coastline, diverse and large population of coastal ocean users, and extensive network of marine protected areas (MPAs) challenges resource management agencies and law enforcement. New domain awareness tools such as GPS-linked data collection and management apps, vessel tracking systems, and remote surveillance technologies can enhance enforcement and management effectiveness and efficiency. Researchers, agencies, and other partners are in the process of exploring how to best acquire, process, and analyze data output from these tools to help resource management agencies understand the spatial and temporal nature of human activity off the coast of California and prioritize areas for management focus.

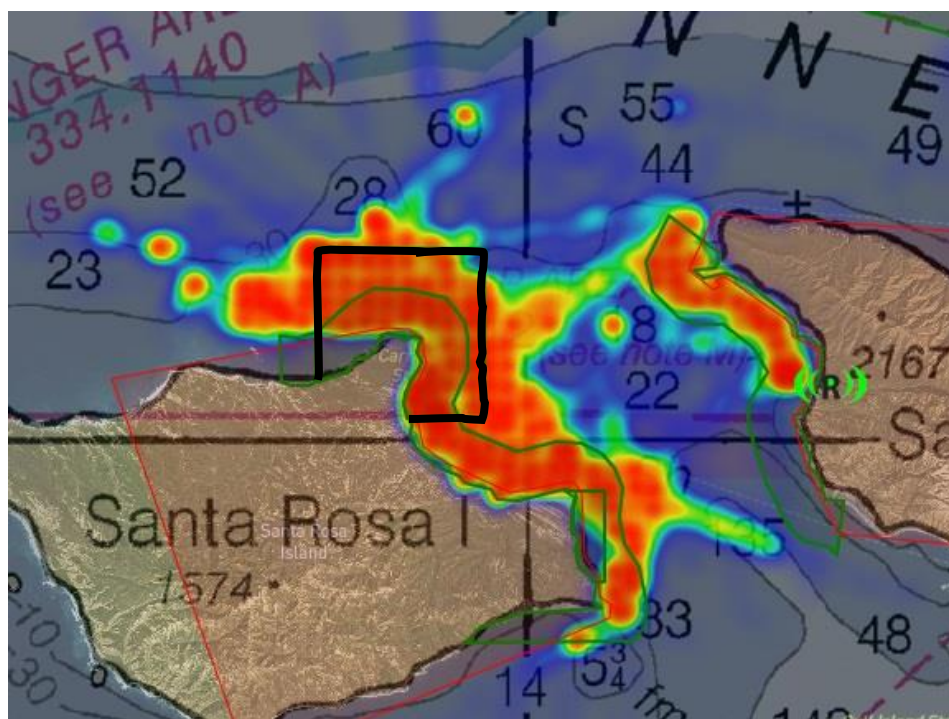
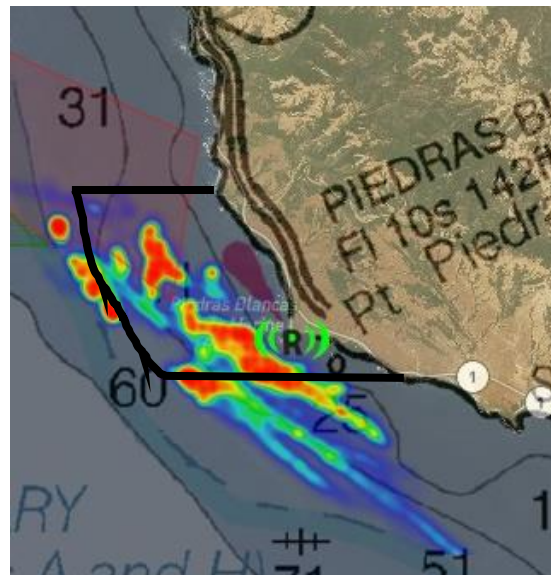
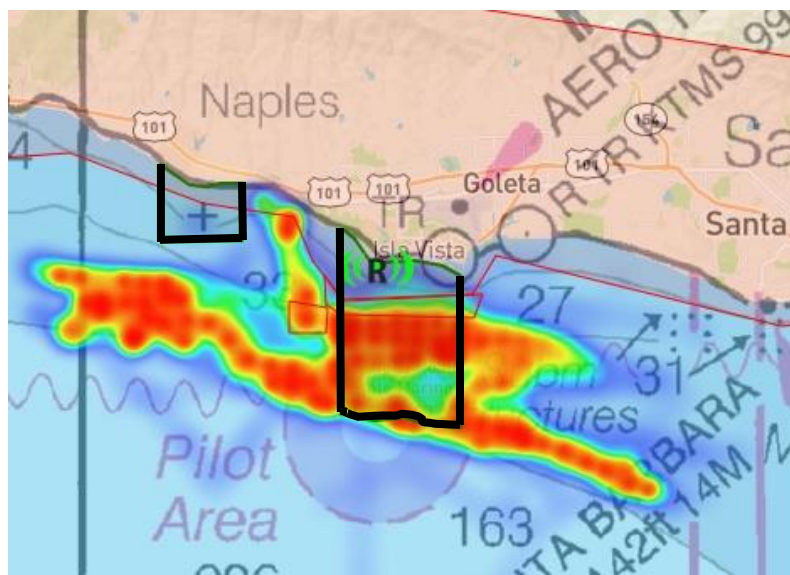
The Marine Monitor radar systems provide autonomous vessel data that can be useful to better understand patterns in activity and inform public safety, resource management, and emergency response efforts. Since July of 2018, through the support of Resources Legacy Fund, the California Marine Sanctuary Foundation and NOAA Channel Islands National Marine Sanctuary have worked to coordinate pilot M2 systems to observe, track, and analyze vessel data within targeted MPAs and surrounding waters in southern California. Building and expanding upon three established installations of shore-based monitoring systems – Coal Oil Point, Santa Cruz Island, and Piedras Blancas – this project seeks to coordinate activities across the M2 sites, including a fourth site in La Jolla managed by WILDCOAST; validate the output of the M2 sites; and communicate their utility to agency partners.



Locations and radar ranges of the Piedras Blancas (upper left), Coal Oil Point (upper right), and Santa Cruz Island (lower) M2 sites



Example analysis products being refined and developed with staff from ProtectedSeas - Maps display density of loitering behavior or areas of concern at Piedras Blancas (upper left), Coal Oil Point (upper right), and Santa Cruz Island (lower) based on M2 radar tracks for all available historical data for each site. Areas with low vessel traffic are shown in dark blue, whereas areas with higher vessel traffic densities are shown in warmer colors (yellow to dark red). Areas with the highest vessel densities are shown in dark red.



Example analysis products being refined and developed with staff from ProtectedSeas – Maps display track density heat maps for M2 tracks that meet alarm criteria from July 1 through October 31, 2018 for Piedras Blancas (upper left), Coal Oil Point (upper right), and Santa Cruz Island (lower) M2 radar systems. Areas with low density of vessel tracks that meet alarm criteria are shown in dark blue, whereas areas with higher densities of vessel tracks that meet alarm criteria are shown in warmer colors (yellow to dark red). Areas with the highest densities are shown in dark red. Marine Protected Areas are shown in black.

Progress To-Date

Project Management

Site-Wide Coordination – The partners have established an overall project management structure for the existing M2 sites within California, including regular communication between partners at ProtectedSeas, NOAA Channel Islands National Marine Sanctuary, the California Marine Sanctuary Foundation, Resources Legacy Fund, WILDCOAST, San Luis Obispo Coastkeeper and CalPoly San Luis Obispo and increased coordination of activities and analyses across California M2 sites.

- Monthly calls have been established, starting in July 2018.
- Discussions with ProtectedSeas and M2 collaborators are ongoing to standardize reporting and analyses to ultimately guide monthly reporting products across sites.
- Partnerships have been developed with on-site colleagues at Coal Oil Point Reserve, The Nature Conservancy, Channel Islands National Park, and Bureau of Land Management staff at Piedras Blancas to help with M2 system reboots and occasional wipe-down of equipment.
- Individual troubleshooting checklists have been created for each M2 site and individual guides/manuals for each site are being developed to help inform future phases of the effort and document lessons learned.
- Surveillance cameras to protect the M2 rig and hardware at Coal Oil Point have been purchased and are awaiting permissions for installation from reserve managers.

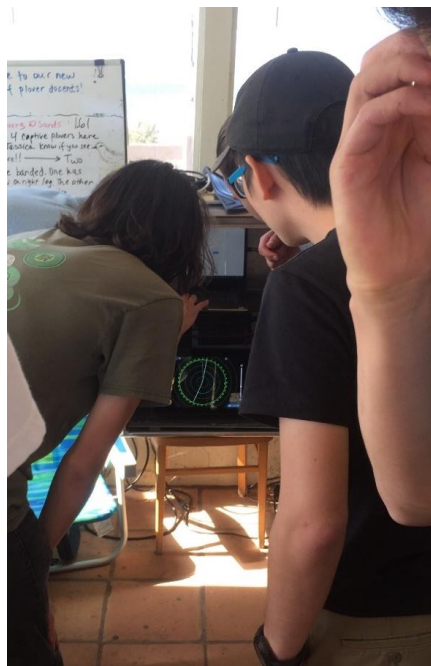
Potential New Site – Potential addition of a new radar system on Anacapa Island is under review by the Ventura County Sheriff's Office of Emergency Services and the National Park Service. The site already includes solar power and established connectivity for data relay.



Photos of potential site at the Anacapa Island foghorn building

Camera at Piedras Blancas – A high definition camera system was reinstalled at the Piedras Blancas site on September 26 and as of early November 2018 is operational and providing images confirming targets on scene within range of the radar system. Condensation gathering on the outside of the lens continues to be an issue and requires bi-weekly trips out to the site for cleaning and maintenance. There is interest in adding an infrared camera at this site.

Camera(s) at Coal Oil Point - The UCSB undergraduate Mechanical Engineering Department has assigned a senior undergraduate Capstone project for the 2018-19 school year focused on integrating camera systems to the Coal Oil Point site. The student group will work to improve methods to stabilize the M2 rig, weather proof the hardware, and explore different camera systems and lens clarities. The students and NOAA Channel Islands National Marine Sanctuary staff are in conversations with camera manufacturer FLIR, who is interested in donating an M400 Multi-Sensor Thermal Night Vision camera system.

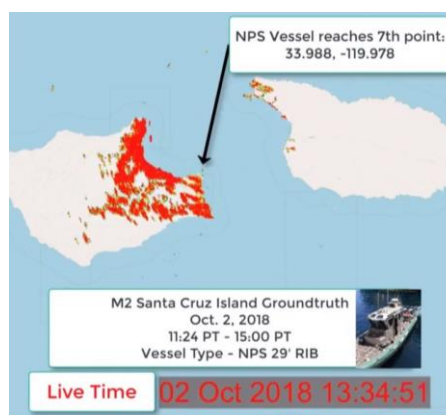


The 2018/19 UCSB undergraduate Mechanical Engineering Capstone team and NOAA Channel Islands National Marine Sanctuary staff checking on and talking through plans for the M2 site at Coal Oil Point

Validation of the M2 Data

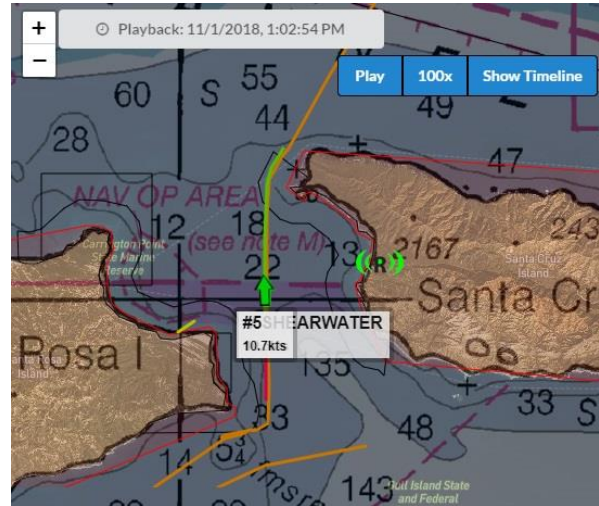
Ground Truthing Exercises – To validate the output of the remote sensing systems, NOAA Channel Islands National Marine Sanctuary and California Marine Sanctuary Foundation staff are completing boat-based ground truthing protocols established and developed by partners at ProtectedSeas and WILDCOAST at the Coal Oil Point, Santa Cruz Island, and Piedras Blancas sites. The ground truthing is designed to help fine tune the radar software settings and acquire GPS tracks that can be used for comparison to verify M2 accuracy.

- On October 2, 2018, staff from NOAA Channel Islands National Marine Sanctuary and National Park Service enforcement partners completed a perimeter track of the range of the Santa Cruz Island site.



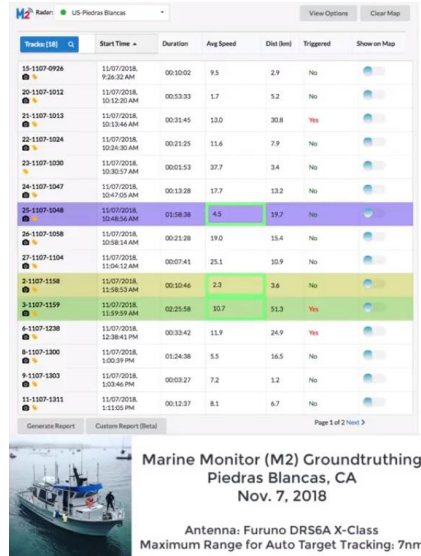
Boat-based ground truthing tracks off of the Santa Cruz Island site (left) and screenshot of ProtectedSeas staff tracking vessel movements in raw M2 data (right)

- On November 1, 2018, the NOAA Shearwater research vessel completed a west to east track of the Santa Cruz Island site range (see map below of track line). GPS track data captured by a Pelagic Data Systems unit installed on the R/V Shearwater will be compared with the M2 geospatial output.



Ground truthing track completed by the NOAA R/V Shearwater on November 1, 2018 off of the Santa Cruz Island site (left) and screenshot of the vessel track lines in the M2 viewer (right)

- On November 7, 2018 staff from NOAA Channel Islands National Marine Sanctuary and the California Marine Sanctuary Foundation completed ground truthing tracks off of Piedras Blancas in a 40' fishing charter vessel using handheld GPS devices.



Boat-based ground truthing track completed on November 7, 2018 off of Piedras Blancas (left) and screenshot of vessel track lines in M2 viewer (right)

Complementary GPS Data Set - To ground truth and validate M2 radar and camera data and confirm the presence of boats and targets, a complementary geospatial dataset is being constructed for comparison with the radar output.

- A data collection app was built within the Fulcrum platform to capture real-time GPS locations. NOAA Channel Islands National Marine Sanctuary staff have been using the app to collect geospatial data on all boat activity within range of the Santa Cruz Island site during monthly aerial surveys. Using timestamps, this geospatial data will later be compared with the M2 radar data to confirm the accuracy of the GPS output and the presence and absence of boats on scene.

Engaging Enforcement Partners

Outreach to Enforcement Partners - Engagement with key enforcement and management personnel from California Department of Fish and Wildlife, United States Coast Guard, and the National Park Service will continue as we work to demonstrate the utility and validity of these remote sensing systems to their enforcement intelligence efforts in these remote regions.

- Updates on the status and capabilities of the Santa Barbara region M2 sites are regularly communicated to United States Coast Guard partners during monthly/quarterly southern California enforcement meetings and conference calls. NOAA Channel Islands National Marine Sanctuary staff continue to engage United States Coast Guard partners on the utility of the M2 viewer as an additional intelligence tool for the region.
- Enforcement personnel from California Department of Fish and Wildlife and United States Coast Guard Station Channel Islands were provided access to the M2 viewer in August 2018 and continued to be engaged on the capabilities and utility of the tool.

Upcoming Activities

- 1) Different camera systems and models will be continue to be researched by the UCSB Mechanical Engineering team and NOAA Channel Islands National Marine Sanctuary staff and incorporated into the M2 sites.
- 2) Individual site manuals for the M2 systems that establish points of contact, site maintenance routines, repair protocols, and hardware and software installation instructions will be completed by December 2018.
- 3) With guidance from partners at ProtectedSeas, ground truthing field exercises to tune and refine the M2 software will continue throughout November and December 2018.
- 4) Conversations will continue with ProtectedSeas and M2 collaborators to refine and develop the monthly spatial analyses and reporting across sites.
- 5) Since the range of shore-based observations is limited by sight distance and rangefinders, satellite data scenes from the USGS Commercial Remote Sensing Space Policy (CRSSP) Imagery Derived Requirements (CIDR) Tool and DitigalGlobe are being explored and will be utilized to build a complementary geospatial dataset that can confirm and verify the geospatial accuracy of the M2 radar output.
- 6) Complementary geospatial data sets will continue to be constructed from NOAA Channel Islands National Marine Sanctuary monthly aerial surveys for comparison with the M2 geospatial data output.
- 7) Coordination with National Park Service and Ventura County Sheriff's Office of Emergency Services partners will continue in pursuit of the establishment of M2 site at the Anacapa Island foghorn building.
- 8) Consideration will be given to the continued location of the Piedras Blancas M2 site and options will be explored related to relocating the M2 system to other priority areas, such as Point Buchon or Point Sur.
- 9) A meeting with high level California Department of Fish and Wildlife law enforcement personnel will be held in early 2019 to share information regarding the Marine Monitor project.