



U.S. Integrated Ocean Observing System (IOOS) Implementation

Southern California Coastal Ocean Observing System (SCCOOS)

FY16-21 National Oceanographic Partnership Program Report:

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University of California, Santa Barbara (UCSB)

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www.sccoos.org

1) PROGRESS AND ACCOMPLISHMENTS

SCCOOS continues to have the ability to achieve its milestones by providing access to high-quality integrated data and support regional user needs while complying with the standards and protocols for sharing and archiving data that are developed nationally. SCCOOS actively participates in IOOS Data Management efforts such as the Thematic Real-Time Environmental Distributed Data Services (THREDDS). By leveraging the Coastal Data Information Program (CDIP) and the HF Radar National Network programs, SCCOOS targets THREDDS distribution for wave, surface currents. Independently, and as a result of certification process that SCCOOS has recently gone through, THREDDS distribution is being explored for shore station data including OA measurements and a fixed mooring with measurements down into the water column. SCCOOS also continues to implement QARTOD data quality control standards. All data have associated ISO 19115 compliant metadata.

As of this year, SCCOOS is a certified Regional Information Coordination Entity, or RICE, a non-federal observing organization recognized as meeting federal standards for data gathering and management. In addition, certification requires that the organization operate inclusively, transparently, and seek user input to determine system priorities. Throughout this process, SCCOOS has successfully implemented data quality control and archival procedures on two types of observing systems, the Automated Shore Stations (Stearns Wharf, Newport Pier, Scripps Pier) and the Burkeolator for measuring carbonate system properties at the Carlsbad Aquafarm. These data follow QARTOD quality control standards and are being archived through the National Centers for Environmental Information (NCEI).

As a result of SCCOOS social media streams (Facebook, Twitter), more ocean observing news items are now widely distributed throughout the RA's, the IOOS program office, as well as the SCCOOS user community.

Climate Variability and Change

1. Operate and maintain a network of glider lines to collect measurements of temperature, salinity, chlorophyll, current velocity, dissolved oxygen and acoustic backscatter; deliver data to SCCOOS website and push to modeling centers.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: The exception is dissolved oxygen. Gliders were equipped with dissolved oxygen sensors that were collecting data until 2012. At that point, the manufacturer (SeaBird) changed the design of the sensor that was being used and the new iteration is not compatible with our gliders. The principle investigator is in the testing phase of adapting the new sensor to the glider fleet. It is undetermined when the new sensor will come online.
 - c. Successes: The experts at the Scripps Oceanography Instrument Development Group, have created a website (<http://spraydata.ucsd.edu>) to explore, glider data and questions such as; what are gliders and how do they do their job, why and how we use gliders, where the Spray Gliders are, and what data are being collected and what kind of projects and publications involve Spray Gliders.
2. Continue to develop integrate and enhance long-term time series products for distribution
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: In partnership with CeNCOOS, SCCOOS has been developing user input of the application and awareness of [C-HARM](#), a modeling tool which predicts harmful algal bloom (HAB) conditions. These predictions are generated daily to provide a forecast of where you

might encounter a *Pseudo-nitzschia* bloom and/or domoic acid event in the next one to three days.

3. Collaborate and integrate new OA observations such as those being deployed by the Santa Monica Bay Restoration and XPrize next generation sensors.
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: Clarissa Anderson, SCCOOS Executive Director, is on a West Coast Ocean Acidification and Hypoxia task force. Born from collaborative conversations with the California Ocean Protection Council and the Ocean Science Trust, SCCOOS has created GIS-based visualized static maps of OAH data that is being collected in California.

Coastal Hazards Milestones

1. Compile database of historical bathymetry surveys. Develop model for Newport and Seal Beach inundation sites.
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: Plots of Southern California beach widths are being updated monthly and posted online annually <http://sccoos.org/projects/cardiff-beach-erosion-inundation/>.
2. Shoreline inundation forecast, validation, and dissemination of warnings to select city managers.
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: Emails are sent to the City of Encinitas When the Cardiff flood index show potential flooding events 3 days in advance.
3. Expand development and integration of inundation web site.
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: Surveys of sand levels on beaches and monitor storm inundations at selected locations are posted on the SCCOOS website. These data are used to validate and refine coastal data and forecast models of erosion, flooding, and inundation levels can be used to protect and improve beaches, real estate, and highways. These endeavors have led to the development of a statewide 'flooding index' forecast plots in accordance with the CDIP current research on wave run-up. The new plots are not based only on the tide and wave height, but also take the wave period into account. The resulting water level predictions are generally lower than those from the old model, but they should be significantly more representative of the actual water levels observed at the coast. The Cardiff CDIP water level page has been updated to include mild and moderate flood thresholds.

Ecosystems, Fisheries and Water Quality

1. Monitor Harmful Algal Blooms (HABs) at five pier stations by collecting weekly measurements of temperature, salinity, chlorophyll, nutrients and toxic species. Provide data online and distribute via the California HABMAP listserv.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: SCCOOS HABs webpage includes Central and Northern California stations. Weekly reports are derived from a year-long time series of sampling for HAB species and related water quality measurements and are provided to the California HAB Monitoring and Alert Program (HABMAP). *Pseudo-nitzschia* blooms that produce domoic acid are being monitored. The Caron lab at the University of Southern California (USC) is responsible for the

analysis of domoic acid from the 5 SCCOOS HAB monitoring sites. The SCCOOS HAB program contributes to the statewide HABMAP program initiated by NOAA, the California Ocean Science Trust, and the Southern California Coastal Water Research Project (SCCWRP).

- c. Successes: The HAB program generates a baseline time-series of ocean properties to monitor ocean conditions in the very near shore zone of the Southern California Bight. These measurements are used to validate the C-HARM forecast model system for short term warnings. They also increase our knowledge of the sign, frequency, and magnitude of variation of temperature, salinity, density, nutrients and pollutants.
2. Continue to collect CalCOFI observations and measurements.
 - a. Completion date: Ongoing milestone
 - a. Status is on track: As part of CalCOFI-LTER program, SCCOOS displays parameters that are measured in the 9-nearshore stations in Southern California including temperature, salinity, zooplankton, phytoplankton, fish eggs and invertebrate larvae. These data are posted online. <http://sccoos.org/data/calcofi/>
 - b. Successes: In 2004, SCCOOS started funding 9 nearshore stations to CalCOFI's standard 66 station pattern. As a result of this partnership SCCOOS links to the CalCOFI's webpage to explore the SCCOOS data that is served on the CalCOFI site. <http://www.calcofi.org/data/sccoos.html>
3. Conduct shipboard observations with CalCOFI surveys to count seabirds; post online.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: Under the auspices of SCCOOS, the California Current Ecosystem Long Term Ecological Research (CCE-LTER) program, and in conjunction with the California Cooperative Oceanic Fisheries Investigations (CalCOFI), the distribution and abundance of seabirds during three seasonal surveys were studied. Survey reports and maps of species' distribution and abundance are published on SCCOOS website. <http://sccoos.org/data/seabirds/>
 - c. Successes: Physical and ecological ocean patterns and processes constitute valuable information for Coastal and Marine Spatial Planning and Marine Protected Area monitoring.
4. Publish survey reports and maps of seabird species' distribution and abundance on SCCOOS website.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: This project is an investigation of changes in the abundance, distribution, and spatial organization of seabirds in the California Current. In this study Farallon Institute biologists make counts of seabirds from fisheries research vessels. Survey reports and maps of species' distribution and abundance are published on SCCOOS website. <http://sccoos.org/data/seabirds/>
 - c. Successes: Farallon Institute Principal Investigator, Bill Sydeman, collaborated on a recent Ecological Applications publication (Jarrod A. Santora, 2017) where it is shown that forage (krill, anchovy, sardine), seabirds, and human fisheries all take place at the same place, these places are persistent between years, and that all of this is related to local upwelling.
5. Display the 3-km ROMS ocean forecasting system for real-time operations statewide.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: 3-km California state-wide ROMS model with 3DVar data assimilation and real-time forecasting capabilities have been running continuously.
 - c. Successes: This state-wide ROMS model is assimilating both the HF Radar surface current data and the vertical profiles of temperature and salinity from four Spray gliders as well as other available observational data sets including satellite sea surface temperature and vertical profiles of temperature and salinity from moorings, ships and floats. In addition to the display

at the SCCOOS web site, we are also displaying some static ROMS images on our group web site.

- i. The ROMS nowcast page: http://west.rssoffice.com/ca_roms?variable=curr
 - ii. The ROMS forecast page: http://west.rssoffice.com/ca_roms_forecast?variable=curr
 - iii. ROMS validation images against three assimilated data sets are also displaying:
1. Satellite SST: http://west.rssoffice.com/ca_roms_valid_other?variable=IRsst
2. HF radar: http://west.rssoffice.com/ca_roms_valid_radar?variable=2
3. Gliders: http://west.rssoffice.com/ca_roms_vaild_prof?variable=sscat
6. Validate the 3-km CA ROMS output against non-assimilated observations.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: In addition to the assimilated data sets, the ROMS nowcast has been validating against a number of non-assimilated data sets.
 - c. Successes: On the daily basis, 20 ensemble model forecast are used in order to quantify errors. Six hourly nowcasts and 72-hour forecast files are available via OpenDAP/THREDDS. A published a skill assessment of the model using these observational platforms is under review (Chao Y. J., 2016). Three validation products have been developed and are being tested on Yi Chao's web site (http://west.rssoffice.com/ca_roms_valid_other?variable=IRsst). The PI is still waiting for the reviews to come back, and will keep SCCOOS informed as he learns more about the review process.
7. Continue to develop and transition 3-km CA ROMS to cloud computing.
 - a. Completion date: Ongoing milestone
 - b. Status is delayed: This project started last year to improve the reliability of our ROMS nowcast/forecast.
 - c. Successes: Every year, there are a few times that the Pasadena office has lost power or other situations when our computer will be down, sometimes for a few hours, and in other rare cases for days. In order for there to be a backup of ROMS data during power issues the PI is testing the feasibility of switching the ROMS model from running on the servers to run via cloud computing. To test this possibility a test account with the Google cloud has been created, and the codes are ready to be operational. They have found out that Google cloud performs better than Microsoft and Amazon clouds, However, we don't have the budget to pay the clouds provider to increase our ROMS operational status from 90-95% to 100% (estimated to be \$10-20K per year depending upon how many times the cloud is used).
8. Develop a coupled ROMS/biogeochemical model to aid the evaluation of the effects of nutrient inputs on bloom formation and nutrient cycles.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: Fine-scale simulations with a research-level, high-resolution ROMS are being analyzed in hindcast mode at UC Los Angeles to examine two phenomena. First, pollution effluent dispersal from the Orange County and Hyperion discharge outfalls are being assessed for their amount of augmentation of net primary productivity in the surrounding shelf regions. Second, the roles of surf current instability and the ensuing surf-eddy turbulence under various wave and coastline shape influences are being assessed how far offshore their influences reach. The progress is posted online <http://sccoos.org/projects/coastal-modeling/>.
 - c. Successes: This project is being done using two tactics; 1) Exploit the surface wave -- current interaction and grid-nesting capabilities of ROMS to examine cross-shore exchange of materials in the shelf and surf zone. Sites near Pt. Conception, the northern Channel Islands, Santa Monica Bay, and the Newport region are the foci, and 2) Develop a coupled ROMS/biogeochemistry/ecosystem model to aid the evaluation of the effects of nutrient inputs

on bloom formation and nutrient cycles, as well as variability and trends in hypoxia and acidification.

9. Continue automated sampling at four shore stations to measure temperature, salinity, chlorophyll, turbidity and water level.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: with exception of the Santa Monica Shore Station, which remains decommissioned (since 7/13/2015). Calibration samples have been collected during cleaning and service dives, however incorporation of data quality checks from four stations is not feasible at the current funding level. SCCOOS stakeholders have been given permission to seek funding for the Santa Monica Shore Station. SCCOOS is still discussing possibilities with interested partners.
 - c. Successes: The automated shore stations program now operates and maintains three stations (Scripps Pier, Newport Pier, and Stearns Wharf) and provides real-time continuous data at 1-4 minute intervals with limited interruptions. Automated shore station data are one of the most requested data sets provided through SCCOOS. These data are used by the public and local state and research agencies (e.g. [Heal the Bay](#), [Santa Monica Bay Restoration Commission](#), [Hyperion](#), [LA WaterKeeper](#), etc.) to assess local conditions related to water quality, nearshore processes, population dynamics of coastal species and harmful algal blooms.
10. Ingest, quality control, disseminate and visualize the mooring data including OA parameters.
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: Data from the Del Mar Mooring is linked to the SCCOOS website <http://sccoos.org/data/overview/>. Quality control, dissemination and visualization of these data is happening as time allows.
11. Ingest, format and visualize the POTWs data for the quarterly hydrographic surveys.
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: SCCOOS continues the initial conversations with POTW's regarding data ingestions, QC and visualization from their quarterly hydrographic surveys as time allows.

Marine Operations Milestones

1. Annually provide training to first responders of maritime incidences in the use of SCCOOS products.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: SCCOOS participates in training and science education to a broad range of stakeholders either by request or as opportunity arises.
 - c. Successes: SCCOOS has an ongoing and collaborative relationship with the oil spill prevention, response and recovery communities in Southern California. What is the oil spill community, you might ask? 1) It's federal, state and local government and agencies. 2) It's oil and gas companies, 3) It's a lot of effort, and SCCOOS spent May 10th and 11th in Oceanside, CA observing it all. Tom Cullen (<https://www.wildlife.ca.gov/OSPR/Administration>), the Administrator of CA Office of Spill Prevention and Response (OSPR), started the day by mentioning the importance of Ocean Observations to all participants in his kick-off speech. Exercises like these allow for the oil spill community to be as prepared as they can, when the real thing happens. This was quite an event to observe, and oil spill exercises happen throughout the year. We learned it takes careful coordination, practice and preparation, as hundreds of people are involved. Oil spills are fraught with the worst challenges, but the oil spill community is filled with concerned citizens, just like you and me.

2. Operate and maintain the network of short, medium and long range HF radar systems and deliver data streams to the National HFR Network.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: SCCOOS HF Radar systems are maintained by four operators: University of California, San Diego; Scripps Institution of Oceanography; University of Southern California; University of California, Santa Barbara; and California Polytechnic State University, San Luis Obispo. HF radar data are aggregated, and HF radar derived surface current maps are distributed for all RAs as well as global partners.
 - c. Successes: SCCOOS leverages High Frequency Network (HFRNet) for total vector calculations, online visualization, data access via web services, and radial and total vector archiving. The live feed of HF radar data are available on the national HFR network for oil and hazardous spill response in the Environmental Response Management Application[®] (ERMA) map viewer for the southwest region. Near real-time and archived surface current measurements have been used in the National Preparedness for Response Exercise Program (NPREP) drill scenarios led by the U.S. Coast Guard in San Diego, Los Angeles and Ventura.
3. Maintain and expand integrated, customized products with multi-layer views of observations, nowcasts and forecasts. Collaborate with the Port of Long Beach to maximize the benefit of SCCOOS observations.
 - a. Completion date: Ongoing milestone
 - b. Status is on track: HF radar derived surface currents are assimilated into the UCLA run Regional Ocean Modeling System (ROMS) which is displayed in an interactive, multilayer visualization in nowcast and hindcast. Additionally, users have the ability to display forecast trajectories through the “drop a drifter” tool to visualize potential paths of surface following objects/substances.
 - c. Successes: SCCOOS uses CDIP's Long Beach Channel Wave Buoy Project with IOOS to create an effort to reach out and educate local, state, and federal agencies, resource managers, industry, policy makers, educators, scientists, non-governmental organizations, and the public. SCCOOS goal is to grow awareness around the importance of ocean observations, and provides outreach support.
4. Deliver surface current data and surface wind analyses to aid spill response, SAR real-time recovery and post analysis trajectories.
 - a. Completion date: Ongoing milestone
 - b. Status is on track
 - c. Successes: Surface current measurements and surface wind analyses are integrated into the General NOAA Operational Modeling Environment (GNOME) for oil spill trajectory analysis. Customized and expanded interactive map displays of wave and surface currents with multi-layered views of observations, nowcasts, and forecasts were developed for Naval Air Systems Command (NAVAIR), at Point Mugu. Implementation of surface currents measured by the SCCOOS HF radar network are now accessible by U.S. Coast Guard for search and rescue (SAR) applications using their Environmental Data Server.
5. Provide HF Radar Quality Control Development.
 - a. Completion date: Milestone Met
 - b. Status is complete, and no longer funded through NOAA/IOOS/SCCOOS
 - c. Successes: A report is underway that aims to explain automated comparisons for IOOS HF Radar quality control.

2) SCOPE OF WORK

SCCOOS operates as a system of partnerships and projects that are facilitated by technical and programmatic staff. Organized by the four focus areas, the SCCOOS scientific and technical approach is based on a system of core ocean observing technologies and the delivery of useful data products and tools. System components include sub-surface ocean observations from underwater gliders, nearshore and coastal measurements, wave measurements and models, pier-based monitoring, satellite imagery, high frequency (HF) radar surface current mapping and data assimilative ocean modeling. The projects described in this report represent the multi-disciplinary and collaborative efforts of the research teams that contribute data and information to SCCOOS.

3) PERSONNEL AND ORGANIZATION STRUCTURE

Dr. Clarissa Anderson became the Executive Director of SCCOOS on January 1, 2017. Julie Thomas was Executive Director until January 2017, and after that point became a SCCOOS Senior Advisor.

In an effort to further expand our Los Angeles network we have added a new Joint Strategic Advisory Committee member, Tom Ford, from Santa Monica Bay Restoration Commission. Tom has provided insight to our future strategies by participating at our Board of Governors meeting. He has also been instrumental in the efforts to seek sustaining funds for the Santa Monica Automated Shore Station.

4) BUDGET ANALYSIS

FY 2016, SCCOOS received an increased allocation of directed funding and a decrease in base funds from FY15. The decrease in base funding (\$78,491) came out of the data management and communication subsystem.

FY16 funding has provided a valuable investment in important assets and will strengthen regional partnerships and national program planning. SCCOOS will continue providing its core observations and expand data products when possible within budget constraints. SCCOOS is also committed to contributing to larger ocean observing efforts regionally, nationally, and internationally.

Expenditures are progressing as expected, with no major discrepancies between actuals and budgeted on both the main award and the subawards.

Works Cited

- Chao, Y. J. (2016). Development, implementation and validation of a California coastal ocean modeling, data assimilation and forecasting system. *Deep Sea Research Part II: Topical Studies in Oceanography*, 26.
- Jarrold A. Santora, W. J. (2017). Persistence of trophic hotspots and relation to human impacts within an upwelling marine ecosystem. *Ecological Applications: Ecological Society of America*, 15.

Environmental Compliance

1) First Responder Training

IOOS/NOAA determined this project has a categorical exclusion, and their statement is as follows: The aforementioned project will not result in any changes to the human environment. As defined in Section 6.03c3(d), Administrative r Routine Program Functions, of NAO 216-6, this project involves conference room and/or classroom training activities that hold no potential for significant environmental

impacts. As such, they should be categorically excluded from the need to prepare an Environmental Assessment or an Environmental Impact Statement.

2) Gliders

IOOS/NOAA determined this project has No Significant Impact, and their state is as follows:

It has been determined that this proposed activity is described in the Final U.S. IOOS Programmatic Environmental Assessment, dated June 2016. The action is covered by the analysis within the U.S. JOOS Program PEA and the signed U.S. IOOS Finding of No Significant Impact. The project and its potential impact may be limited through terms or conditions placed on receipt of NOAA funds. The action requires no further environmental review.

3) Shore Stations

IOOS/NOAA determined this project has No Significant Impact, and their state is as follows:

It has been determined that this proposed activity is described in the Final U.S. IOOS Programmatic Environmental Assessment, dated June 2016. The action is covered by the analysis within the U.S. JOOS Program PEA and the signed U.S. IOOS Finding of No Significant Impact. The project and its potential impact may be limited through terms or conditions placed on receipt of NOAA funds. The action requires no further environmental review.

4) Vessel Sampling – CalCOFI

IOOS/NOAA determined this project has No Significant Impact, and their state is as follows:

It has been determined that this proposed activity is described in the Final U.S. IOOS Programmatic Environmental Assessment, dated June 2016. The action is covered by the analysis within the U.S. JOOS Program PEA and the signed U.S. IOOS Finding of No Significant Impact. The project and its potential impact may be limited through terms or conditions placed on receipt of NOAA funds. The action requires no further environmental review.

5) Mooring

IOOS/NOAA determined this project has No Significant Impact, and their state is as follows:

It has been determined that this proposed activity is described in the Final U.S. IOOS Programmatic Environmental Assessment, dated June 2016. The action is covered by the analysis within the U.S. JOOS Program PEA and the signed U.S. IOOS Finding of No Significant Impact. The project and its potential impact may be limited through terms or conditions placed on receipt of NOAA funds. The action requires no further environmental review.

The project and its potential impact may be limited through the following terms or conditions placed on receipt of NOAA funds:

- A permit is in place to allow the mooring to reside in its location: Below is the permits for the Del Mar Mooring Activities under the subject award.
- SCCOOS projects have implemented the Essential Fish Habitat Conservation Recommendations provided by NMFS on July 7, 2014 to avoid, minimize, or offset effects of this activity.

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
RADIO STATION CONSTRUCTION PERMIT
AND LICENSE

EXPERIMENTAL

(Nature of Service)

XR FX

(Class of Station)

WI2XAA

(Call Sign)

0539-EX-PL-2015

(File Number)

NAME Scripps Institution Of Oceanography

Subject to the provisions of the Communications Act of 1934, subsequent acts, and treaties, and all regulations heretofore or hereafter made by this Commission, and further subject to the conditions and requirements set forth in this license, the licensee hereof is hereby authorized to use and operate the radio transmitting facilities hereinafter described for radio communications in accordance with the program of experimentation described by the licensee in its application for license.

Operation: In accordance with Sec. 5.3(d) of the Commission's Rules

Station Locations

- (1) Santa Barbara Channel, within 32 km, PC - NL 34-18-31; WL 120-48-15
- (2) Pacific Ocean,, within 32 km, PC - NL 33-31-41; WL 122-30-15
- (3) Pacific Ocean, within 32 km, PC - NL 32-55-48; WL 117-18-57

Frequency Information

Santa Barbara Channel, within 32 km, PC - NL 34-18-31; WL 120-48-15

Frequency	Station Class	Emission Designator	Authorized Power	Frequency Tolerance (+/-)
161.975-162.025 MHz	FX	25K0F1D	12.5 W (ERP)	0.00015 %

Pacific Ocean,, within 32 km, PC - NL 33-31-41; WL 122-30-15

Frequency	Station Class	Emission Designator	Authorized Power	Frequency Tolerance (+/-)
161.975-162.025 MHz	FX	25K0F1D	12.5 W (ERP)	0.00015 %

This authorization effective November 09, 2015 and
will expire 3:00 A.M. EST November 01, 2017

**FEDERAL
COMMUNICATIONS
COMMISSION**



Frequency Information

Pacific Ocean, within 32 km, PC - NL 32-55-48; WL 117-18-57

Frequency	Station Class	Emission Designator	Authorized Power	Frequency Tolerance (+/-)
161.975-162.025 MHz	FX	25K0F1D	12.5 W (ERP)	0.00015 %

Special Conditions:

- (1) The occupied bandwidth of the emission shall not extend beyond the band limits set forth above.