U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

MEMORANDUM FOR: Captain Robert Kamphaus, NOAA
Commanding Officer, NOAA Ship *Ronald H. Brown*

FROM: Captain Anne K. Lynch, NOAA
Commanding Officer, NOAA Marine Operations Center-Atlantic

SUBJECT: Project Instruction for RB-16-04
West Coast Ocean Acidification Study

Attached is the final Project Instruction for RB-16-04, West Coast Ocean Acidification Study, which is scheduled aboard NOAA Ship *Ronald H. Brown* during the period of May 5 – June 7, 2016. Of the 34 DAS scheduled for this project, 34 days are funded by a Line Office Allocation. This project is estimated to exhibit a High Operational Tempo. Acknowledge receipt of these instructions via e-mail to **ChiefOps.MOA@noaa.gov** at Marine Operations Center-Atlantic.

PMEL

Pacific Marine Environmental Laboratory

FINAL Project Instructions

Date Submitted: April 11, 2016

Platform: NOAA Ship *Ronald H Brown*

Project Number: RH-16-04

Project Title: West Coast Ocean Acidification Study

Project Dates: **May 5, 2016 to June 7, 2016**

Prepared by: _____ Dated: 4-18-16

Dr. Simone R. Alin
Chief Scientist
NOAA-PMEL

Approved by: _____ Dated: 4-18-2016

Dr. Richard A. Feely
Chief Scientist
NOAA-PMEL

Approved by: _____ Dated: 4-19-2016

for Dr. Christopher L. Sabine
Director
NOAA-PMEL

Approved by: _____ Dated: 4/20/2016

Captain Anne K. Lynch, NOAA
Commanding Officer
Marine Operations Center – Atlantic

I. Overview

A. NOAA Ship *Ronald H Brown* will participate in multiple deployments and recoveries of a CTD and 24-position Niskin bottle rosette in support of ocean acidification research, along transect lines and at moored sensor locations. There will be additional ancillary projects, including deployment of smaller sensor packages by hand and by winch, continuous underway pCO_2 monitoring via the ship's scientific uncontaminated seawater line, deployment of Argo floats, collection of phytoplankton and zooplankton by net tows with winch, and on-board incubations of phytoplankton and zooplankton.

B. Days at Sea (DAS): Of the 34 DAS scheduled for this project, 0 DAS are funded by an OMAO allocation, 34 DAS are funded by a Line Office allocation, 0 DAS are Program Funded, and 0 DAS are Other Agency Funded. This project is estimated to exhibit a High Operational Tempo.

C. The cruise will start out from San Diego, CA, and proceed southward to offshore Baja California, Mexico, where the water column sampling will commence. We have planned a series of 16 transect lines of varying length roughly orthogonal to the Pacific Coast of the North American continent, from northern Baja California, Mexico, to just south of the Queen Charlotte Islands, British Columbia, Canada. Full water column CTD stations will be occupied at specified locations along the planned transects. We will occupy as many of these planned stations as time and conditions allow. The water collected will be analyzed for a variety of physical, chemical, and biological parameters. During the in-port stop in San Francisco dividing legs one and two of the project, we will exchange several science party team members (8 science team members will depart, and 11–13 will board). Other than personal items, we do not plan to load or unload any equipment. At the end of the proposed sampling plan, the ship will dock in Seattle to disembark/de-stage.

Cruise waypoints and station locations are listed in a Microsoft Excel file, jpg file, and coastal navigator (nob) file that can be found here:
http://www.pmel.noaa.gov/co2/dg/WCOA2016/

Final decisions on station locations and sample sequence will be determined on a day-by-day basis by the chief scientist in consultation with the Captain and officers of the *Ronald H Brown* as weather and shipboard circumstances permit.

D. Summary of Objectives:

Cruise Overview: In support of NOAA's Ocean Acidification Program, NOAA will conduct a cruise along the Pacific coast to survey ocean acidification (OA) conditions on the continental shelf. The major objectives of the cruise are:
1) To characterize ocean acidification (OA) conditions on the U.S. west coast;

2) To conduct inter-calibration measurements near other OA observing assets in the study area, such as moorings, allowing inter-calibration of these autonomous assets with high-quality, ship-based measurements;
3) To provide calibration data needed to develop predictive models for aragonite saturation state, pH, and other important OA indicators in the California Current System, based on widely measured parameters such as salinity, temperature, and oxygen concentration;
4) To provide quantitative assessment of microbial, phytoplankton, zooplankton, and harmful algal bloom activity in conjunction with OA measurements; and
5) To provide scientific information on OA conditions and trends for resource management and decision support.

The California Current System, running along the North American west coast from British Columbia to Baja California, is a region where seasonal upwelling brings old, nutrient and CO_2-rich and O_2-poor waters to the surface. It is an area of intense biogeochemical cycling, with high rates of primary production, air-sea CO_2 exchange, and carbon export to the open ocean and sediments. Retention and recycling of material on the continental shelf are particularly high in the northern part of the California Current System, and these features predispose ecosystems in this region to being particularly susceptible to the impacts of decreased calcium carbonate saturation resulting from a combination of ocean acidification and natural processes along the west coast (upwelling, river inputs, seasonal development of hypoxia). Understanding the progression of OA in our coastal oceans in the context of these other natural processes is critical for developing management, mitigation, and adaptation strategies for coastal resources. The cruise will also provide a large-scale picture of ocean acidification along the North American west coast that will give many other observing assets in the coastal ocean a larger context, including existing and planned moorings, repeat glider transects, and tests of wave gliders and other new technologies.

E. Participating Institutions

United States Institutions

- NOAA Pacific Marine Environmental Laboratory (PMEL)
- University of Washington Joint Institute for the Study of the Atmosphere and Ocean (JISAO)
- UW School of Oceanography (UW-SOO)
- UW School of Marine and Environmental Affairs (UW-SMEA)
- NOAA Northwest Fisheries Science Center (NWFSC)
- Oregon State University (OSU)
- University of South Florida (USF)
- NOAA Ocean Acidification Program (OAP)
- NOAA National Environmental Satellite, Data, and Information Service (NESDIS)

- San Francisco State University (SFSU)
- Stanford University (SU)

International Institutions

- Institute of Ocean Sciences, Department of Fisheries and Oceans, Canada (IOS)
- University of Victoria, British Columbia, Canada (UVic)
- Universidad Autónoma de Baja California, Mexico (UABC)
- Hakai Institute, British Columbia, Canada (HIBC)
- University of Amsterdam, Netherlands (UAN)
- Novia University of Applied Sciences, Finland (NUAS)

F. Personnel/Science Party: name, title, gender, affiliation, and nationality

Name (Last, First)	**Title**	**Date Aboard**	**Date Disembark**	**Gen-der**	**Affilia-tion**	**Nation-ality**	**Le g**
Alin, Simone	Chief Scientist	05/04/16	05/21/16	F	PMEL	US	1
Davelaar, Martin	Scientist, Canadian representative	05/04/16	05/21/16	M	IOS	Canada	1
Greeley, Dana	Co-chief scientist	05/04/16	05/21/16	M	PMEL	US	1
Hernandez Ayon, José Martin	Scientist, Mexican representative	05/04/16	05/21/16	M	UABC	Mexico	1
Hodgson, Emma	Scientist	05/04/16	05/21/16	F	UW	US	1
Hubbard, Dale	Scientist	05/04/16	05/21/16	M	OSU	US	1
Ward, Melissa	Scientist	05/04/16	05/21/16	F	UCD	US	1
Bednarsek, Nina	Scientist	05/04/16	06/07/16	F	UW-SMEA	Slovenia	1,2
Bill, Brian	Scientist	05/04/16	06/07/16	M	NWFSC	US	1,2
Carter, Brendan	Scientist	05/04/16	06/07/16	M	JISAO	US	1,2
Cuyler, Erin	Scientist	05/04/16	06/07/16	F	USF	US	1,2
Douglas, Katie	Scientist	05/04/16	06/07/16	F	USF	US	1,2
Herndon, Julian	Scientist	05/04/16	06/07/16	M	JISAO	US	1,2
Ikeda, Chris	Scientist	05/04/16	06/07/16	M	SFSU	US	1,2
Kovach, Charles	Scientist	05/04/16	06/07/16	M	NESDIS	US	1,2
Liu, Sherwood	Scientist	05/04/16	06/07/16	M	USF	US	1,2
McCabe, Ryan	Scientist	05/04/16	06/07/16	M	JISAO	US	1,2
Mekkes, Lisette	Scientist	05/04/16	06/07/16	F	UAN	Netherlands	1,2
Salo, Sigrid	Scientist	05/04/16	06/07/16	F	PMEL	US	1,2
Sharp, Jon	Scientist	05/04/16	06/07/16	M	USF	US	1,2

Cosca, Cathy	Data manager	05/21/16	06/07/16	F	PMEL	US	2
Engida, Zelalem	Scientist, Canadian representative	05/21/16	06/07/16	M	UVic	Canada and/or Ethiopia	2
Engström-Öst, Jonna	Scientist	05/21/16	06/07/16	F	NUAS	Finland	2
Evans, Wiley	Scientist, Canadian representative	05/21/16	06/07/16	M	HIBC	US	2
Feely, Richard	Chief Scientist	05/21/16	06/07/16	M	PMEL	US	2
Glippa, Olivier	Scientist	05/21/16	06/07/16	M	NUAS	France	2
Johnson, Kevin	Scientist	05/21/16	06/07/16	M	UCSB	US	2
McLaskey, Anna	Scientist	05/21/16	06/07/16	F	UW	US	2
Nilsson, William B.	Scientist	05/21/16	06/07/16	M	NWFSC	US	2
Ostendorf, Morgan	Scientist	05/21/16	06/07/16	F	JISAO	US	2
Radach, Katrina	Scientist	05/21/16	06/07/16	F	UW	US	2
Rhodes, Linda D.	Scientist	05/21/16	06/07/16	F	NWFSC	US	2
Shea, Meghan	Scientist	05/21/16	06/07/16	F	SU	US	2
Showalter, Spencer	Scientist	05/21/16	06/07/16	F	NWFSC	US	2
Weekes, Carrie	Scientist	05/21/16	06/07/16	F	OSU	US	2

G. Administrative

1. Points of Contacts:

Chief Scientists:
Dr. Simone Alin (1st leg), Dr. Richard A. Feely (2nd leg),
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Seattle, WA 98115
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2. Diplomatic Clearances

This project involves Marine Scientific Research in waters under the jurisdiction of Mexico and Canada. Diplomatic clearance has been requested.

Canada (xxxxxxxx) Mexico (xxxxxxxx)

3. Licenses and Permits

None required for sites within NOAA National Marine Sanctuaries, as we do not have any equipment that will touch bottom or be left at the surface or in the water column beyond when the ship is physically present at the site.

II. Operations

The Chief Scientist is responsible for ensuring the scientific staff are trained in planned operations and are knowledgeable of project objectives and priorities. The Commanding Officer is responsible for ensuring all operations conform to the ship's accepted practices and procedures.

A. Project Itinerary:

A more detailed itinerary can be found here:
http://www.pmel.noaa.gov/co2/dg/WCOA2016/
An overview is presented here:

Start	Stop	Operation
May 3	May 4	Load, set up, and secure equipment and van on ship.
May 5	May 7	Transit to first CTD station in the vicinity of 24.92°N and 115.05°W. Sampling of CO_2 and other parameters from the ship's underway seawater line will commence. Net tows will begin along this line of stations.

May 7	May 21	CTD stations, underway sampling, and net tows.
May 21	May 22	Transfer of chief scientists (Dr. Feely to replace Dr. Alin) and several other science team members in San Francisco.
May 22	June 5	CTD stations, underway sampling, and net tows continue to last CTD station in the vicinity of 52.4°N and 129.05°W, or as far as we are able to get in the available time.
June 5	June 7	Transit to Seattle (underway sampling continues).
June 8	June 8	Unload all equipment and samples, disembark.

B. Staging and Destaging:

Staging: The NOAA Ship *Ronald H Brown* is expected to arrive at San Diego on April 25th or soon thereafter. We would like to commence all staging activities described below not later than May 3rd as agreeable to the ship. These activities include:

- Loading one van and two CTD units onto the ship.
- Connecting the van with required utilities. The van is a standard 8' x 20' shipping container converted to a sea-going laboratory. It will weigh approximately 13,000 lbs on board. It will require 480V power and uses a 15KVA Transformer, fresh water, ethernet, phone, and compressed air.
- Loading the following equipment with either the ship's crane or a rented crane: a fish tote (47" x 44" x 33" w/ approx. weight of 200 lbs), bongo frame, and the ~80 lb weight used for the nets plus two pallets with oxygen analysis equipment. *We also hope there are one or more hand trucks from the ship that we could utilize.*
- The scientific party will work to prepare analytical systems for the cruise during normal work hours to the extent possible.
- The remaining scientific equipment will be brought onboard by hand throughout the staging period.
- Install tanks for incubating phytoplankton and zooplankton caught during the cruise for experimental work. For phytoplankton, the incubation chamber may be installed on deck. For zooplankton, we have in the past done the incubations in a wet lab, but this may be negotiable, depending on the ship's facilities. There will be gas cylinders associated with this work.

Container Information:

- Approximate weight on ship: 13,500 lbs.

- Size: standard container: 8' W x 8.5' H x 20' L
- Power input: Square D Transformer, EE15T3H: 3 Phase, Primary - 480V, Secondary - 208Y/120; Frequency Rating - 60Hz; 30 A.
- We provide a 35' power cable that plugs into our transformer.
- The other end of the cable currently has a Russell Stohl connector: #JPS334H. This would plug into a JRS334H, JRSA334H, or similar receptacle. Most ships require a different plug that they provide and wire up after disconnecting our JPS334H.

Container Needs:

- Compressed air at a minimum of 70 psi (we have a 100' air line). Our air line will connect on our end via a dead-light pass-through in our vestibule.
- Fresh water (we use at most approximately 10 gallons per day) - we will supply our own garden hose (25 or 50') to connect with your supply. It connects on our end in our vestibule.
- Phone - if you have a special phone that needs a different connection than the standard US one, please advise. We have a connection in our vestibule.
- Ethernet - we can supply a 100' cat 5 cable. We have a connection in our vestibule.
- Sink drain - we have 20' or so of drain line. This would flow from a 1.5" drain pipe in our vestibule.
- We have our own Air Conditioner/Heater installed in the vestibule. It is powered via our transformer and power panel/breaker box. In case you wish to know, it is a Daikin 24K Heat Pump model # FTXS24LVJU & RX24LVJU.

It is the responsibility of the scientists to arrange for shipment of their equipment and van to NOAA Ship *Ronald H Brown* in San Diego. The project, in coordination with the Operations Officer, will arrange for the shore crane during the staging period.

De-staging: On June 7/8, one laboratory van, the CTD frames, and any other large scientific equipment will be offloaded in Seattle with the use of a shore crane (most likely from NESS). The rest of the scientific equipment will be de-staged and offloaded manually June 7–8 (one or more hand trucks from the ship would be helpful).

It is the responsibility of the scientists to arrange for shipment of their equipment and vans from the *Ronald H Brown* in Seattle. The project, in coordination with the Operations Officer, will arrange for the shore crane in Seattle.

C. Operations to be Conducted:

The cruise will consist of continuous underway measurements and CTD/net tow stations from south to north along approximately 17 transit lines. Operations will be conducted on a 24-hours-per-day basis. The desired transit speed will be 10–12 knots between stations, depending on sea state and proximity to shore (12 kts between stations that are far apart, 10 kts as stations are closer together in nearshore areas). We request a slower transit speed between stations that are close together to allow the shift scientists sufficient time to sample the CTD/rosette after each cast before conducting the next cast.

For the underway system, we request that the ship's seawater flow-through system be cleaned and thoroughly flushed prior to the cruise. The previous survey tech would put 1/2 gallon of bleach in the instrument chest in the bow, start the pump for a minute, let it stand for 30 minutes or longer, and then thoroughly flush ALL outlets, including the ones in nutrient lab and main lab.

The CTD rosette underwater package (primary) will be provided by the PMEL science party. It will be comprised of a Sea-Bird Electronics (SBE) 9plus CTD with dual temperature, conductivity, and dissolved oxygen sensors; an SBE 32 carousel water sampler and 24 12-liter Niskin bottles; an altimeter; and a Sea-Point chlorophyll fluorometer. 24-Hz data will be acquired using the *Ronald H Brown* SBE 11plus deck unit and a personal computer provided by PMEL in a lab space with clean power and cool temperature. CTD casts at each station will be conducted from the surface to 10 m above the bottom, with a maximum depth near 3,000 m. Water samples will be collected from the Niskin bottles after each cast.

Table 1. CTD equipment needed on cruise, number of units, and source from which equipment will be borrowed.

Description	Make/model info	for full a CTD	needed -	Primary	Backup
Computers for running SEASAVE		1	2	RH Brown	RH Brown
Deck unit	SBE-11plus	1	2	RH Brown	RH Brown
CTD (incl. stainless guard cage)	SBE-9plus	1	2	Science	RH Brown
Aluminum Frame, 24 position		1	2	Science	Science
Rosette pylon (carousel)	SBE 24-position	1	2	Science	Science
Pump for CTD	SBE 05T (slim,	2	4	Science	Science
Conductivity sensors	SBE 04 (model?)	2	4	Science	RH Brown
Temperature sensors	SBE03 (model?)	2	4	Science	RH Brown
oxygen	SBE43	2	4	Science	Science
Bottles	11L CFC custom-	24	60	Science	Science
Spare/repair bottle parts		kit		Science	Science
Single and Y cables for dual cond, temp, pump and O2 instruments		TBD	TBD	Science (wet-pluggable)	RH Brown (not wet-pluggable)
Valeport altimeter		1	2	Science	Science
Seapoint Chlorophyll fluorometer (6000m		1	2	Science	Science
Manuals w/wiring diagrams	all above			Science	RH Brown

The ship will provide a working winch with 6000 m of 0.322" conducting cable and spare slip rings; as well as a method for monitoring winch speed, wire tension, and wire out and communicating with the winch operator. Ship's personnel will be required to run the winch, and two persons will be needed to assist with the deployment and recovery of the underwater package during 24-hour operations. The ship's ET will be required to terminate the sea cable and troubleshoot if necessary. The science team plans to run CTD casts off the ship's SEASAVE computer. Science team will bring two laptops along for preliminary processing of CTD data.

In addition to the CTD stations and underway sampling, there will be three types of net tows we will conduct. Vertical plankton tows (VPT) will be done at several CTD stations on each line. The focus will be on the CTD stations with total depth around the 80–90 db range, but more will be included on a case-by-case basis with coordination and pre-approval of the ship. The same can be said for the Bongo (horizontal) tows, but those will only occur at mostly at nighttime. Both tows will go down to a maximum depth of 100 meters utilizing a wire speed of 30 meters per minute. We will need the ship to be stationary for the VPT and underway at ~2 kt for the Bongo tows. Neuston net tows will be done at a limited number of sites. Bongo tows last for ~20-30 min, neuston tows require a shorter duration.

We will also have partners from NOAA's National Environmental Satellite, Data, and Information Service on board conducting validation measurements for Ocean Color satellite observations. They will deploy by hand a profiling sensor package (photo a below) that will descend to a maximum of 100 m depth (more typically to 20 m depth) three times while the ship is on station. The profiling would only occur during the day and require up to 30 minutes to complete. At a subset of these stations, it would be desirable to do an additional CTD cast with a separate, smaller CTD frame and sensor package (photo b below). This package carries absorption and backscatter sensors (ACS and BB9, respectively). This cast would take on the order of 20 min to complete and would ideally be done from a separate winch to avoid needing to switch CTD packages on the main winch. Given that the Brown has only two winches, we prefer to switch the nets off at stations where the smaller CTD package is deployed.

We plan to deploy on the order of two Argo floats on the West Coast OA cruise. The most likely stations are the two outermost stations of transect line 7, but this may change.

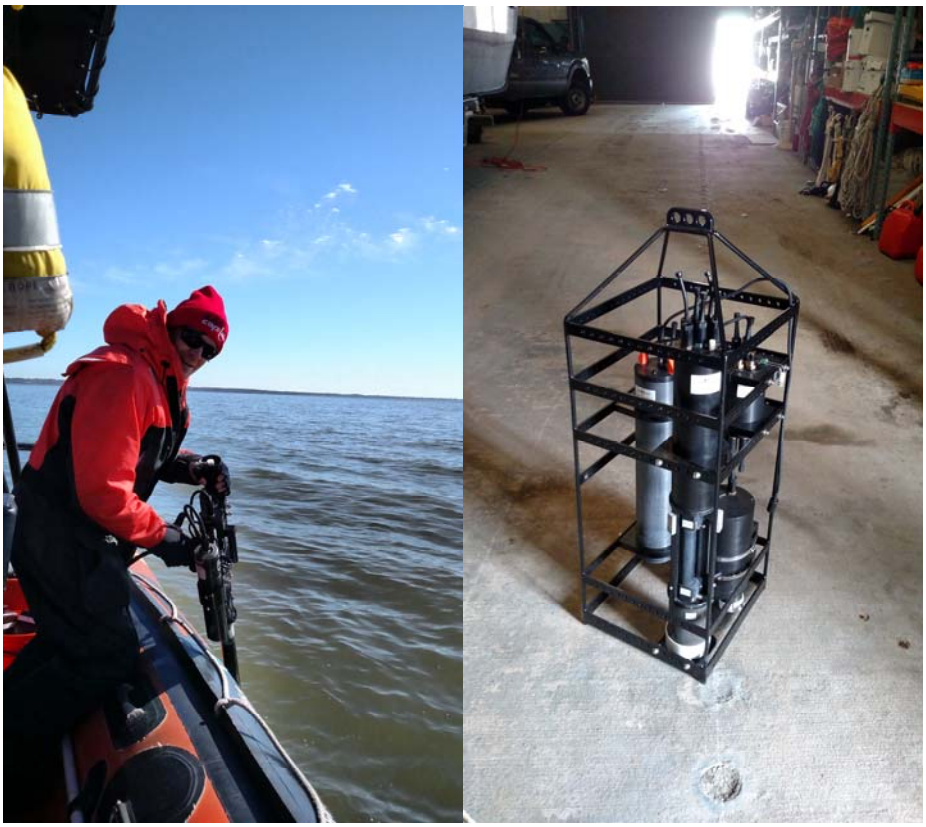

Figure caption. Pictured above are a) the hyperpro package and b) the smaller CTD package, with backscatter and absorption instruments.

Columbia River Stations:

Three Columbia River CTD sampling stations are included in the project plan to be completed on or about May 29th. The station latitudes and longitudes are included below. These stations should take no longer than 30 minutes and consist of a single CTD cast at each station with eight Niskin bottle samples. The ability to sample at these stations will depend on conditions at the river entrance on the sampling day. Tides, currents, marine traffic, bar conditions, weather conditions and many other variables may have an impact on the possibility of executing these stations. The ship will make the final determination on conducting these stations as we approach, and they will only be done during daylight hours. These three stations can be completed in any order desired by the ship's officers so as to ensure safe operations.

Station 101: 46.245°N | 124.1100°W
Station 102: 46.250°N | 124.0033°W
Station 103: 46.190°N | 123.9117°W

D. Dive Plan:

Dives are not planned for this project.

E. Applicable Restrictions:

Conditions that preclude normal operations: Poor weather, equipment failure, unforeseen conditions, and ice coverage would all preclude normal operations. Poor weather would have to be waited out or the project track would have to be modified to provide the best weather possible. A-frame or winch failures would need to be addressed immediately for the project to continue.

III. Equipment

A. Equipment and Capabilities provided by the ship (itemized)

The following systems and their associated support services are essential to the cruise. Sufficient consumables, back-up units, and on-site spare parts and technical support must be in place to assure that operational interruptions are minimal. All measurement instruments are expected to have current calibrations, and all pertinent calibration information shall be included in the data package.

a. Navigational systems including high-resolution GPS.

b. CTD deck units (SBE-11plus) – primary plus back-up.

c. Two back-up CTD Packages (SBE-9plus) plus spare conductivity and temperature sensors. We request that these all have recently been calibrated.

d. Thermosalinograph calibrated to within 0.1°C and 0.01 ppt.

e. Dry compressed air (70 psi, 4 CFM), power, fresh water, phone, and Ethernet connections to van.

f. Continuously flowing uncontaminated seawater to the underway CO_2 system (4 L/min) and an additional X L/min for an underway pCO_2/TCO_2 system.

g. Refrigerator space for seawater samples (no chemicals). We need +4°C refrigerator space and can provide an estimate of the volume needed soon.

h. Freezer space for seawater samples and biological samples (no chemicals). We need freezer space at both –20°C and –80°C and can provide an estimate of the volume needed soon.

i. Real-time SCS feed of selected ship data (GPS, barometric pressure, salinity, and intake seawater temperature) for the AOML underway CO_2 system.

j. Access to flow-through seawater system for underway sampling for chlorophyll and phytoplankton absorption samples.

k. ADCP running, data collection maintained.

l. Meteorological observations running, data collection maintained.

m. Communications bandwidth to support daily downloads of satellite imagery, estimated to be 10–20 MB daily.

B. Equipment and Capabilities provided by the scientists (itemized)

a. Chemical reagents and compressed gases will be located in the research Van or another secure, appropriate storage location (e.g. ship's small hazmat locker). A complete listing of all chemicals to be brought onboard is included in the Hazardous Materials section. Material Data Safety Sheets (MSDS) will be provided to the ship before any chemicals are loaded.

b. CTD/Rosette Package plus spares (see table in section II C for details).

c. Sampling nets and other equipment needed to sample and process phytoplankton and zooplankton samples (e.g. filters, filtration apparatuses, microscopes, etc.).

d. Equipment for making hyperspectral observations, which will need a location to be secured on deck between stations.

i. Profiling optical packages (over the side): Hyperpro, AC9, Backscatter/Fluorometer, and BB9 and DH4.

ii. Atmospheric (on deck): Microtops hand-held sun photometer

iii. DI-water system for instrument calibrations.

e. Other consumables, i.e., pens, pencils, paper, data storage media, etc.

IV. Hazardous Materials

A. Policy and Compliance

The Chief Scientist is responsible for complying with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it). By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all

hazardous materials by name and quantity, MSDS, appropriate spill cleanup materials (neutralizing agents, buffers, or absorbents) in amounts adequate to address spills of a size equal to the amount of chemical brought aboard, and chemical safety and spill response procedures. . Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

Per OMAO procedure, the scientific party will include with their project instructions and provide to the CO of the respective ship 30 days before departure:

- List of chemicals by name with anticipated quantity
- List of spill response materials, including neutralizing agents, buffers, and absorbents
- Chemical safety and spill response procedures, such as excerpts of the program's Chemical Hygiene Plan or SOPs relevant for shipboard laboratories
- For bulk quantities of chemicals in excess of 50 gallons total or in containers larger than 10 gallons each, notify ship's Operations Officer regarding quantity, packaging and chemical to verify safe stowage is available as soon as chemical quantities are known.

Upon embarkation and prior to loading hazardous materials aboard the vessel, the scientific party will provide to the CO or their designee:

- An inventory list showing actual amount of hazardous material brought aboard
- An MSDS for each material
- Confirmation that neutralizing agents and spill equipment were brought aboard sufficient to contain and cleanup all of the hazardous material brought aboard by the program
- Confirmation that chemical safety and spill response procedures were brought aboard

Upon departure from the ship, scientific parties will provide the CO or their designee an inventory showing that all chemicals were removed from the vessel. The CO's designee will maintain a log to track scientific party hazardous materials. MSDS will be made available to the ship's complement, in compliance with Hazard Communication Laws.

Scientific parties are expected to manage and respond to spills of scientific hazardous materials. Overboard discharge of hazardous materials is not permitted aboard NOAA ships.

B. Inventory

Hazardous Materials Inventory: Current inventory here:

http://www.pmel.noaa.gov/co2/dg/WCOA2016

Common Name of Material	Qty	Location on board	Contact	Spill control
Acetone	4 x 1L	DIC Van	Greeley	S
CO2	4 lecture bottles	DIC Van	Greeley	NA
Compressed Gas, nos: 500ppm CO2 in Nitrogen	1 tank	DIC Van	Greeley	NA
Magnesium Perchlorate	2 x 1 Kg	DIC Van	Greeley	G
Mercuric Chloride	2 x 10g	DIC Van	Greeley	M
Nitrogen	1 tank	DIC Van	Greeley	NA
Phosphoric Acid	2 x 500ml	DIC Van	Greeley	A
Soda Lime	2 x 1 Kg	DIC Van	Greeley	C
Ascarite II, Fine (20-30 Mesh)	2 x 500g	TAlk	Herndon	G,X
Drierite, Indicating (10-20 mesh)	1x5lb	TAlk	Herndon	G,X
Hydrochloric Acid, 0.1N	20x500ml	TAlk	Herndon	A
Formaldehyde solution, 37%	5 L	TBD	Bednarsek	F
95% Ethanol	65 x 1 L	TBD	Bednarsek	S
Calcein	1 x 200 g	TBD	Bednarsek	G,X
Compressed Air	18 tanks?	TBD	Bednarsek	NA
Lead Perchlorate, 0.022M	4 x 50ml	pH, CO3	Douglas	G
Metacresol Purple, 0.010M	2 x 50ml	pH, CO3	Douglas	G
Hydrochloric Acid, 1.0N	1 x 100ml	pH, CO3	Douglas	A
Sodium Hydroxide, 1.0N	1 x 15ml	pH, CO3	Douglas	C
RNAlater	1 x 500ml		K. Johnson	
95% Ethanol	1 x 500ml		K. Johnson	S
Liquid nitrogen	1 x 25 L	TBD	Kovach/Ondrusek	NA
bromo-deoxyuridine (BrdU)	250 mg	Main lab?	Rhodes/Nilsson	G
0.5 M sodium hydroxide	1 L	Main lab?	Rhodes/Nilsson	C
1.5 M sodium chloride	1 L	Main lab?	Rhodes/Nilsson	S
0.5 M Tris hydrochloride+A33 pH 7.8	1 L	Main lab?	Rhodes/Nilsson	S
10% paraformaldehyde	10 ml	Main lab?	Rhodes/Nilsson	F
Formaldehyde Solution, 20%	1L	TBD	Bill/Ikeda	F
Hydrochloric Acid, 1.0N	2 x 4L	TBD	Bill/Ikeda	A

Phosphoric Acid, 44.6N	2 x 500mL	TBD	Bill/Ikeda	A
Sufuric Acid, 36N	2 x 500mL	TBD	Bill/Ikeda	A
Ferric Chloride	3 x 0.1g	TBD	Bill/Ikeda	G
2,3-Butanedione monoxime	3 x 5g	TBD	Bill/Ikeda	G
Thiosemicarbazide	3 x 0.05g	TBD	Bill/Ikeda	G
Sodium Sulfite	2 x 1g	TBD	Bill/Ikeda	G
Sodium Tetraborate Decahydrate	2 x 80g	TBD	Bill/Ikeda	G
O-Phthalaldehyde	2 x 4g	TBD	Bill/Ikeda	G
Ethanol	2 x 500mL	TBD	Bill/Ikeda	S
Acetone	1 x 4L	TBD	Bill/Ikeda	S
Sodium Nitrate 0.01M	1 x 1L	TBD	Bill/Ikeda	G
Sodium meta-silicate nonahydrate 0.05M	1 x 1L	TBD	Bill/Ikeda	G
Sodium phosphate dibasic anhydrous 0.01M	1 x 1L	TBD	Bill/Ikeda	G

	Oxygen estimates below		
manganous chloride solution	2 L	Hubbard	G
sodium iodate solution	2 L	Hubbard	G
sodium thiosulfate solution	4 L	Hubbard	G
sulfuric acid, 30 %	2 L	Hubbard	A
Winkler's reagent: sodium hydroxide / sodium iodide	2 L	Hubbard	C

Spill Control

A: ACID

Wear appropriate protective equipment and clothing during clean-up. Keep upwind. Keep out of low areas. Ventilate closed spaces before entering them.
Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible.
Large Spills: Dike far ahead of spill for later disposal. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal.
Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.
Never return spills in original containers for re-use.
Neutralize spill area and washings with soda ash or lime. Collect in a non-combustible container for prompt disposal.
J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this product.

C: Caustics:

Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric.

F: Formalin/Formaldehyde

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust.

G: General Spill

Wear appropriate personal protective equipment. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. If dry, sweep up, if wet, soak up with absorbent material. Either one, containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal. Following product recovery, wipe or flush area with water.

M: Mercury

Spills: Pick up and place in a suitable container for reclamation or disposal in a method that does not generate dust. Sprinkle area with sulfur or calcium polysulfide to suppress mercury. Use PMEL Mercury Spill Kit if need be.

P: Phenol

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Collect in a non-combustible container for prompt disposal.
Never return spills in original containers for re-use. Clean up in accordance with all applicable regulations. Neutralize spill area and washings with soda ash or lime. Collect in a non-combustible container for prompt disposal.

S: Solvents

ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Use only non-sparking tools. All equipment used when handling the product must be grounded.
Large Spills: Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Dike far ahead of spill for later disposal.
Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Collect in a non-combustible container for prompt disposal. Never return spills in original containers for re-use. Clean surface thoroughly to remove residual contamination.
1-5 gallon bucket of Spill X-S adsorbent is recommended and will handle up to 3.2 gallons of Acetone.

X: Virtually Harmless

Small Quantities of less than 5 gallons/pounds should be collected in a ziplock or bucket and marked as "used".

Spill Kit Contents to be brought on-board:

1: 30 gal. drum. - blue, poly with the following inside:
1: 5 lb bucket of Spill X-S: Adsorbs many organic solvents and fuels (other than organic peroxides or hydrazine compounds). Carbon-based adsorbent reduces vapors and can raise the flash point to above 140° when applied properly. Quantity Adsorbed per Container (in gallons)
Acetone : 3.2 Gallons
Ethanol : 1.9 Gallons
Toluene : 1.9 Gallons
Xylene: 2.4 Gallons

1: Spill X-A Acid Spill Kit. Contains six 2.5 lb containers of neutralizer. Each container treats up to a one-gallon spill. Treats much more if the acid is not full strength. More info here: http://www.ansul.com/AnsulGetDoc.asp?FileID=23574

3: 1 gal pails - white, plastic + covers
1: Portable Mercury Kit
1: Anti static Scoop - 1 quart
Many: Quart size zip-loc bags
Many: Gallon size zip-loc bags

Personal Protective Equipment:
2: R95 respirator (dust masks) for nuisance level acid gas relief
1: XL Tyvek Body coverall
1: Medium Tyvek body coverall
10: Large Silvershield Gloves
3: Stealth Teal Frame Uvex Goggles

D. Radioactive Materials

No Radioactive Isotopes are planned for this project

E. Inventory (itemized) of Radioactive Materials

N/A

V. Additional Projects

A. Supplementary ("Piggyback") Projects

No Supplementary Projects are planned.

B. NOAA Fleet Ancillary Projects

No NOAA Fleet Ancillary Projects are planned.

VI. Disposition of Data and Reports

At the end of the cruise, the Chief Survey Technician will provide the Chief Scientist with copies of data from the ship's SCS system, barometer measurements, log sheets, TSG data, rain sensor data, wind speed and direction data, ship's navigation log data, speed logs, winch system, ADCP, Fluorometer data, ADCP data, and any other logged scientific data. The number of copies of each data set will be worked out between the Chief Scientist and Chief Survey Technician.

Disposition of data gathered aboard NOAA ships will conform to NAO 216-101 *Ocean Data Acquisitions* and NAO 212-15 *Management of Environmental Data and Information.* To guide the implementation of these NAOs, NOAA's Environmental Data Management Committee (EDMC) provides the *NOAA Data Documentation Procedural Directive* (data documentation) and *NOAA Data Management Planning Procedural Directive* (preparation of Data Management Plans). OMAO is developing procedures and allocating resources to manage OMAO data and Programs are encouraged to do the same for their Project data.

A. Data Classifications: *Under Development*

a. OMAO Data

b. Program Data

B. Responsibilities: *Under Development*

VII. Meetings, Vessel Familiarization, and Project Evaluations

A. Pre-Project Meeting: The Chief Scientist and Commanding Officer will conduct a meeting of pertinent members of the scientific party and ship's crew to discuss required equipment, planned operations, concerns, and establish mitigation strategies for all concerns. This meeting shall be conducted before the beginning of the project with sufficient time to allow for preparation of the ship and project personnel. The ship's Operations Officer usually is delegated to assist the Chief Scientist in arranging this meeting.

B. Vessel Familiarization Meeting: The Commanding Officer is responsible for ensuring scientific personnel are familiarized with applicable sections of the standing orders and vessel protocols, e.g., meals, watches, etiquette, drills, etc. A

vessel familiarization meeting shall be conducted in the first 24 hours of the project's start and is normally presented by the ship's Operations Officer.

C. Post-Project Meeting: The Commanding Officer is responsible for conducted a meeting no earlier than 24 hrs before or 7 days after the completion of a project to discuss the overall success and short comings of the project. Concerns regarding safety, efficiency, and suggestions for future improvements shall be discussed and mitigations for future projects will be documented for future use. This meeting shall be attended by the ship's officers, applicable crew, the Chief Scientist, and members of the scientific party and is normally arranged by the Operations Officer and Chief Scientist.

D. Project Evaluation Report

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Chief Scientist. The form is available at http://www.omao.noaa.gov/fleeteval.html and provides a "Submit" button at the end of the form. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the ships', specific concerns and praises are followed up on while not divulging the identity of the evaluator.

VIII. Miscellaneous

A. Meals and Berthing

The ship will provide meals for the scientists listed above. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the project, and ending two hours after the termination of the project. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least seven days prior to the project.

Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the Chief Scientist. The Chief Scientist and Commanding Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current make-up of the ship's complement. The Chief Scientist is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The Chief Scientist is also responsible for the

cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the project and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The Chief Scientist will ensure that all non NOAA or non Federal scientists aboard also have proper orders. It is the responsibility of the Chief Scientist to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 17, 2000 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts

The NOAA Health Services Questionnaire (NHSQ, NF 57-10-01 (3-14)) must be completed in advance by each participating scientist. The NHSQ can be obtained from the Chief Scientist or the NOAA website http://www.corporateservices.noaa.gov/noaaforms/eforms/nf57-10-01.pdf.

All NHSQs submitted after March 1, 2014 must be accompanied by NOAA Form (NF) 57-10-02 - Tuberculosis Screening Document in compliance with OMAO Policy 1008 (Tuberculosis Protection Program).

The completed forms should be sent to the Regional Director of Health Services at the applicable Marine Operations Center. The NHSQ and Tuberculosis Screening Document should reach the Health Services Office no later than 4 weeks prior to the start of the project to allow time for the participant to obtain and submit additional information should health services require it, before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of either form. Ensure to fully complete each form and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

The participant can mail, fax, or email the forms to the contact information below. Participants should take precautions to protect their Personally Identifiable Information (PII) and medical information and ensure all correspondence adheres to DOC guidance (http://ocio.os.doc.gov/ITPolicyandPrograms/IT_Privacy/PROD01_008240).

The only secure email process approved by NOAA is Accellion Secure File Transfer, which requires the sender to setup an account. Accellion's Web Users Guide is a valuable aid in using this service, however to reduce cost the DOC contract doesn't provide for automatically issuing full functioning accounts. To receive access to a "Send Tab", after your Accellion account has been established send an email from the associated email account to accellionAlerts@doc.gov requesting access to the "Send Tab" function. They will notify you via email usually within 1 business day of your approval. The 'Send Tab" function will be accessible for 30 days.

Contact information:

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757-441-6320
Fax 757-441-3760
Email MOA.Health.Services@noaa.gov

Prior to departure, the Chief Scientist must provide an electronic listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: contact name, address, relationship to member, and telephone number.

C. Shipboard Safety

Hard hats are required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. Hard hats and work vests will be provided by the ship when required.

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. At the discretion of the ship CO, safety shoes (i.e. steel or composite toe protection) may be required to participate in any work dealing with suspended loads, including CTD deployment and recovery. The ship does not provide safety-toed shoes/boots. The ship's Operations Officer should be consulted by the Chief Scientist to ensure members of the scientific party report aboard with the proper attire.

D. Communications

A progress report on operations prepared by the Chief Scientist may be relayed to the program office. Sometimes it is necessary for the Chief Scientist to communicate with another vessel, aircraft, or shore facility. Through various means of communications, the ship can usually accommodate the Chief Scientist. Special radio voice communications

requirements should be listed in the project instructions. The ship's primary means of communication with the Marine Operations Center is via email and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth at 128kbs is shared by all vessels staff and the science team at no charge. Increased bandwidth in 30 day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required and it must be arranged through the ship's Commanding Officer at least 30 days in advance.

E. IT Security

Any computer that will be hooked into the ship's network must comply with the *OMAO Fleet IT Security Policy* 1.1 (November 4, 2005) prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

(1) Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.
(2) Installation of the latest critical operating system security patches.
(3) No external public Internet Service Provider (ISP) connections.

Completion of the above requirements prior to boarding the ship is required.

Non-NOAA personnel using the ship's computers or connecting their own computers to the ship's network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo (http://deemedexports.noaa.gov). National Marine Fisheries Service personnel will use the Foreign National Registration System (FNRS) to submit requests for access to NOAA facilities and ships. The Departmental Sponsor/NOAA (DSN) is responsible for obtaining clearances and export licenses and for providing escorts required by the NAO. DSNs should consult with their designated Line Office Deemed Export point of contact to assist with the process.

Full compliance with NAO 207-12 is required.

Responsibilities of the Chief Scientist:

1. Provide the Commanding Officer with the email generated by the Servicing Security Office granting approval for the foreign national guest's visit. (For NMFS-sponsored guests, this email will be transmitted by FNRS.) This email will identify the guest's DSN and will serve as evidence that the requirements of NAO 207-12 have been complied with.

2. Escorts – The Chief Scientist is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer.
3. Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the Servicing Security Office.
4. Export Control - Ensure that approved controls are in place for any technologies that are subject to Export Administration Regulations (EAR).

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Responsibilities of the Commanding Officer:

1. Ensure only those foreign nationals with DOC/OSY clearance are granted access.
2. Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written approval from the Director of the Office of Marine and Aviation Operations and compliance with export and sanction regulations.
3. Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.
4. Ensure receipt from the Chief Scientist or the DSN of the FNRS or Servicing Security Office email granting approval for the foreign national guest's visit.
5. Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.
6. Export Control - 8 weeks in advance of the project, provide the Chief Scientist with a current inventory of OMAO controlled technology onboard the vessel and a copy of the vessel Technology Access Control Plan (TACP). Also notify the Chief Scientist of any OMAO-sponsored foreign nationals that will be onboard while program equipment is aboard so that the Chief Scientist can take steps to prevent unlicensed export of Program controlled technology. The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.
7. Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the Servicing Security Office.

Responsibilities of the Foreign National Sponsor:

1. Export Control - The foreign national's sponsor is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior

to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.

2. The DSN of the foreign national shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen and a NOAA or DOC employee. According to DOC/OSY, this requirement cannot be altered.
3. Ensure completion and submission of Appendix C (Certification of Conditions and Responsibilities for a Foreign National

Foreign national sponsors for the cruise will be Simone Alin and Dana Greeley on leg 1 and Richard Feely and Cathy Cosca on leg 2.

VIII. Appendices

Appendix A: Station List

Latest information should be obtained from this url:
http://www.pmel.noaa.gov/co2/dg/WCOA2016

Line	Sta	Long	Lat	Btm depth
0	999*	-117.3145	32.6591	87.8
1	1	-114.7280	25.0852	3000.0
1	2	-114.4098	25.2518	3000.0
1	3	-114.0937	25.4183	3000.0
1	4	-113.7750	25.5850	3000.0
1	5	-113.4572	25.7508	857.0
1	6	-113.1368	25.9180	184.0
1	7	-112.8175	26.0850	78.0
1	8	-112.6331	26.1794	25.0
2	9	-116.1890	27.3860	3000.0
2	10	-115.8688	27.5527	3000.0
2	11	-115.5413	27.7195	2270.0
2	12	-115.4098	27.7862	295.0
2	13	-115.2853	27.8525	92.0
2	14	-114.8920	28.0528	76.0
2	15	-114.5705	28.2197	87.5
2	16	-114.2342	28.3867	44.5
2	17	-114.1410	28.4371	25.0
3	18	-118.7883	30.6855	2607.0
3	19	-118.4540	30.8523	2359.0
3	20	-118.1200	31.0188	1734.0
3	21	-117.7863	31.1855	1744.0

3	22	-117.4512	31.3518	1900.0
3	23	-117.1080	31.5192	1230.0
3	24	-116.9063	31.6180	1135.0
3	25	-116.7730	31.6852	396.0
3	26	-116.7267	31.7064	91.4
4	27	-120.9000	31.9507	3000.0
4	28	-120.0966	32.3450	2130.0
4	29	-119.7012	32.5390	914.0
4	30	-118.4230	33.1597	1250.0
4	31	-118.0356	33.3494	735.0
4	32	-117.7708	33.4812	80.0
4	33	-117.7545	33.4890	41.0
4	34	-117.7481	33.4923	25.6
5	35	-122.4953	33.5248	3000.0
5	36	-121.1593	34.1405	2280.0
5	37	-121.0227	34.2055	1125.0
5	38	-120.7890	34.3144	746.0
5	39	-120.6536	34.3774	427.0
5	40	-120.5799	34.4109	187.0
5	41	-120.5133	34.4405	79.0
5	42	-120.4864	34.4522	45.0
5	43	-120.4817	34.4543	25.6
6	44	-122.7350	36.4017	3000.0
6	45	-122.4345	36.5240	2216.0
6	46	-122.0624	36.6962	1530.0
6	47	-122.0204	36.7124	380.0
6	48	-121.9692	36.7356	122.0
6	49	-121.9272	36.7568	100.0
6	50	-121.8722	36.7837	264.0
6	51	-121.8484	36.7952	298.0
6	52	-121.8185	36.8097	31.1
7	53	-125.6446	36.6670	3000.0
7	54	-124.3077	37.2865	3000.0
7	55	-123.4814	37.6662	2908.0
7	56	-123.3170	37.7502	1011.0
7	57	-123.2757	37.7617	518.0
7	58	-123.0713	37.8632	91.0
7	59	-122.9817	37.9030	69.0
7	60	-122.8805	37.9434	48.0
7	61	-122.8277	37.9714	29.3

	SF Pilot Buoy	-122.4585	37.8186	0.0
	San Francisco	-122.4172	37.8105	0.0
	San Francisco	-122.4172	37.8105	0.0
	SF Pilot Buoy	-122.4585	37.8186	0.0
8	62	-125.2062	39.8850	2520.0
8	63	-124.9368	40.0033	1502.0
8	64	-124.7111	40.1027	932.0
8	65	-124.4841	40.2028	270.0
8	66	-124.4451	40.2200	125.0
8	67	-124.4117	40.2338	94.0
8	68	-124.3840	40.2460	55.0
8	69	-124.3721	40.2510	27.4
9	70	-126.6797	41.5095	2900.0
9	71	-125.6570	41.7200	2800.0
9	72	-125.0474	41.8441	1205.0
9	73	-124.7950	41.8985	740.0
9	74	-124.5846	41.9443	320.0
9	75	-124.4859	41.9616	111.0
9	76	-124.4167	41.9750	82.0
9	77	-124.3290	41.9935	40.0
9	78	-124.2856	42.0000	27.4
10	79	-124.9810	44.2000	337.0
10	80	-124.5770	44.2000	104.0
10	81	-124.4223	44.2000	93.0
10	82	-124.2613	44.2000	74.0
10	83	-124.1671	44.2000	45.0
10	84	-124.1390	44.2000	25.6
11	85	-124.1000	44.6517	25.6
11	86	-124.1300	44.6517	50.0
11	87	-124.2950	44.6517	80.0
11	88	-124.6500	44.6517	296.0
11	89	-124.7750	44.6517	435.0
11	90	-125.0000	44.6517	970.0
11	91	-125.1167	44.6517	700.0
11	92	-125.3667	44.6517	2885.0
11	93	-125.6000	44.6517	2860.0
12	94	-125.1883	46.1300	1360.0
12	95	-124.9114	46.1300	1341.0

12	96	-124.6702	46.1300	291.0
12	97	-124.5269	46.1300	136.0
12	98	-124.2678	46.1300	91.0
12	99	-124.0917	46.1300	41.0
12	100	-124.0333	46.1300	24.4
12	101	-124.1100	46.2450	20.0
12	102	-124.0033	46.2500	26.0
12	103	-123.9117	46.1900	25.0
13	104	-124.2500	47.1167	21.0
13	105	-124.3863	47.1167	51.0
13	106	-124.6442	47.1167	93.0
13	107	-124.7300	47.3500	30.0
13	108	-124.8195	47.1167	138.0
13	109	-124.9829	47.1167	447.0
13	110	-125.0553	47.1167	1064.0
13	111	-125.1957	47.1167	1618.0
13	112	-126.0850	47.1200	2506.0
14	113	-125.5799	47.6800	1115.0
14	114	-125.3292	47.9600	492.0
14	115*	-124.7046	47.8738	34.7
14	116*	-124.7333	47.9667	29.3
14	117	-124.9499	47.9700	30.0
14	118	-125.1746	48.1300	233.0
14	119	-124.9512	48.3700	119.0
14	120	-124.7917	48.3700	78.6
15	121	-125.4215	48.8644	36.6
15	122	-125.4644	48.8400	96.0
15	123	-125.5160	48.8100	110.0
15	124	-125.5710	48.7800	127.0
15	125	-125.6759	48.7200	165.0
15	126	-125.7838	48.6579	64.0
15	127	-125.8857	48.5995	92.0
15	128	-125.9983	48.5348	126.0
15	129	-126.1180	48.4910	198.0
15	130	-126.2280	48.4320	613.0
15	131	-126.3081	48.3568	1234.0
15	132	-126.4146	48.2959	1478.0
15	133	-126.6041	48.1866	2510.0
15	134	-127.1000	47.9000	2560.0
16	135	-132.8183	50.7183	2944.0

16	136	-132.1750	51.0167	2756.0
16	137	-131.5350	51.3067	2358.0
16	138	-130.8767	51.6000	2028.0
16	139	-130.6333	51.7083	928.0
16	140	-130.3717	51.8300	238.0
16	141	-129.9700	52.0167	133.0
16	142	-129.4500	52.2333	170.0
16	143	-129.0491	52.3992	45.7
16	144	-128.2380	51.7020	40.0

2. Station Plot