UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
Marine Operations Center
439 W. York Street
Norfolk, VA 23510-1114

JUL 10 2015

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-15-04
Gulf of Alaska Ocean Acidification Survey

Attached is the final Project Instruction for RB-15-04, Gulf of Alaska Ocean Acidification Survey, which is scheduled aboard NOAA Ship *Ronald H. Brown* during the period of July 13 – August 1, 2015. Of the 20 DAS scheduled for this project, 20 DAS 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 **OpsMgr.MOA@noaa.gov** at Marine Operations Center-Atlantic.

cc:
Natalie Monacci
Jessica Cross
Christopher Sabine

PMEL

Pacific Marine Environmental Laboratory

Final Project Instructions

Date Submitted: June 19, 2015

Platform: NOAA Ship *Ronald H. Brown*

Project Number: RB-15-04

Project Title: Gulf of Alaska Ocean Acidification Survey

Project Dates: July 13 to August 1, 2015

Prepared by: _____ Dated: 6/22/15
Natalie Monacci
University of Alaska Fairbanks

Approved by: _____ Dated: 6/22/15
Dr. Jessica Cross
Chief Scientist
NOAA-PMEL

Approved by: _____ Dated: 6/22/15
Dr. Christopher L. Sabine
Director
NOAA-PMEL

Approved by: _____ Dated: 7/10/15
CAPT Anne K. Lynch, NOAA
Commanding Officer
Marine Operations Center - Atlantic

I. Overview

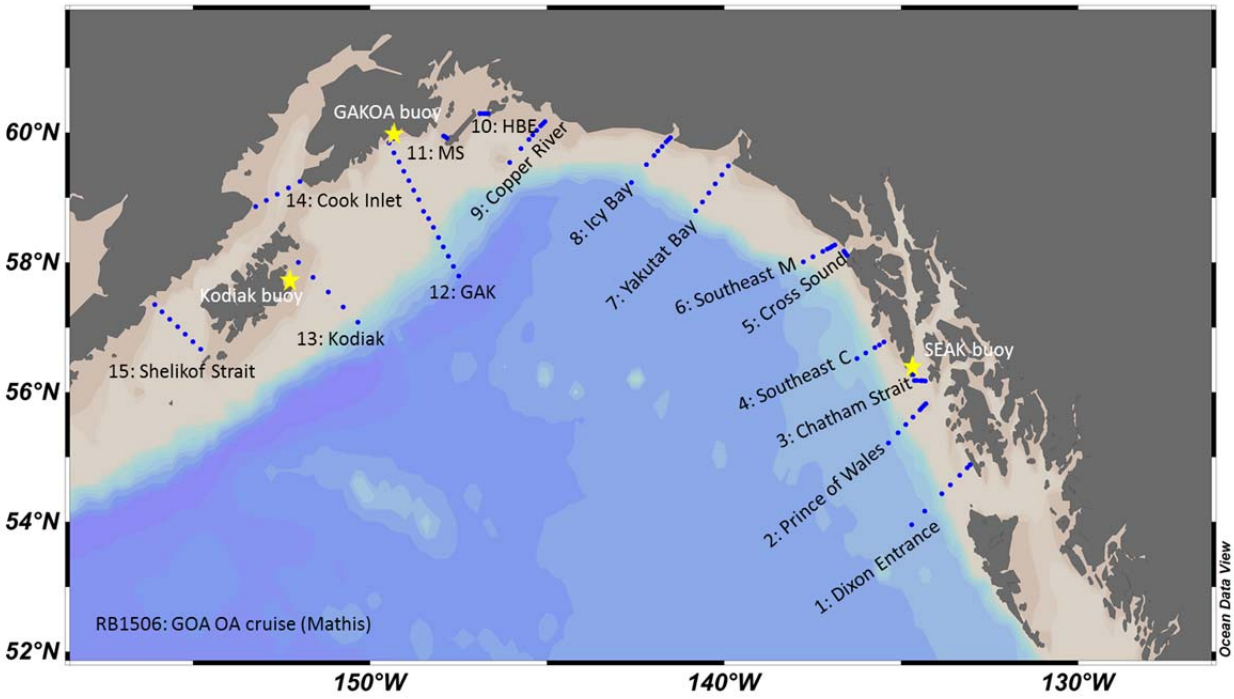
A. This project will be a hydrographic survey of the Gulf of Alaska as part of NOAA's Ocean Acidification Program (OAP), July 13, 2015 to August 1, 2015.

B. Days at Sea (DAS)

Of the 20 DAS for this project, 0 DAS are funded by an OMAO allocation, 20 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. Operating Area

Gulf of Alaska from Dixon Entrance to Shelikof Strait, south of Kodiak.



D. Summary of Objectives:

Cruise Overview: PMEL will load equipment when *Brown* is in Seattle between the dates of July 6 and 10, 2015. A minimum of sixteen scientific staff members

will embark the vessel in Seattle WA on July 12, 2015. The ship departs Seattle on July 13, 2015 and will transit north to the first sample transect near Dixon Entrance. During transit, the science party will be setting up and testing analytical equipment. Upon arrival, underway measurements will commence (see Appendix C.)

Sampling will be done at 15 transects and 100 stations (see map), as well as proximal to three surface moorings (see Appendix A). Sampling will begin near Dixon Entrance and conclude in Shelikof Strait. Each station will include CTD casts with water samples at various depths, bongo net tows, and hand tows.

Water samples will be collected from the Niskins on the CTD and will either be analyzed with analytical instrumentation at sea (carbon, oxygen, and chlorophyll measurements) or they will be frozen to be analyzed after the cruise (nutrients).

Hand tows will be conducted by tying a 3-foot net to a cleat or the ship's rail, taking a 5 gallon bucket surface sample over the side using a line, and pouring the surface water through the tied off net.

Argo floats will be released during this expedition. The Chief Scientist will coordinate this program. These floats may need to be unpacked prior to deployment, preferably while the CTD is in the water. Floats will be deployed at designated stations immediately following completion of the final cast at that station, as the ship gets underway. Deployment involves lowering the ~20 kg float by hand into the water from the stern of the ship, with the ship slowly steaming ahead at < 5 kts. One or two persons from the ship and scientific party will be required for preparation and deployment. Shortly after deployments the following information should be e-mailed to PMEL_Floats@noaa.gov:

Float serial number
Deployment date and time (GMT)
Deployment latitude and longitude
Ship name
Deployer name(s)
Station number for the closest CTD
Any comments (problems with deployment, etc)

E. Participating Institutions:

- NOAA Pacific Marine Environmental Laboratory (PMEL)
  7600 Sand Point Way N.E., Seattle, Washington 98115
- University of Alaska Fairbanks (UAF)

School of Fisheries and Ocean Sciences
905 N. Koyukuk Drive, 245 O'Neill, Fairbanks, Alaska, 99775-7220

- NOAA Alaska Fisheries Science Center
  7600 Sand Point Way N.E., Seattle, Washington 98115

F. Personnel/Science Party:

Name (Last, First)	Title	Date Aboard	Date Disembark	Gender	Affiliation	Nationality
Cross, Jessica	Ch. Scientist	12 July	1 Aug	female	PMEL	USA
Evans, Wiley	Scientist	12 July	1 Aug	male	PMEL	USA
Ostendorf, Morgan	Scientist	12 July	1 Aug	female	PMEL	USA
Monacci, Natalie	Scientist	12 July	1 Aug	female	UAF	USA
Rivera, Patricia	Scientist	12 July	1 Aug	female	UAF	USA
Questel, Jennifer	Scientist	12 July	1 Aug	female	UAF	USA
Smoot, Caitlin	Scientist	12 July	1 Aug	female	UAF	USA
Kaplan, Rachel	Scientist	12 July	1 Aug	female	UAF	USA
Naber, Daniel	Scientist	12 July	1 Aug	male	UAF	USA
Shoenfeld, Max	Scientist	12 July	1 Aug	male	UAF	USA
Herndon, Julian	Scientist	12 July	1 Aug	male	PMEL	USA
Beaumont, Katie	Scientist	12 July	1 Aug	female	PMEL	USA
Pretty, Jessica	Scientist	12 July	1 Aug	female	UAF	USA

G. Administrative

1. Points of Contacts

Dr. Jeremy Mathis
Principal Investigator
NOAA PMEL
7600 Sand Point Way NE, Bldg 3
Seattle, WA 98115
206-526-4809
jeremy.mathis @noaa.gov

Natalie Monacci
UAF-SFOS
905 N. Koyukuk Drive
245 O'Neill
Fairbanks, AK 99775
907-474-7956
nmonacci@alaska.edu

LT Adrienne Hopper
Operations Officer, NOAA Ship *Ronald H. Brown*
Adrienne.hopper@noaa.gov
301-713-7783 VOIP

2. Diplomatic Clearances

None Required.

3. Licenses and Permits

None Required.

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:

July 7, 2015	Load equipment aboard vessel.
July 12, 2015	Embark 16 science party members in Seattle, WA.
July 13- August 1, 2015	Transit north. Occupy science stations.
August 1, 2015	Transit to Kodiak to tie up.

B. Staging and Destaging

The ship will arrive in Seattle July (TBD) at the conclusion of gear trials and will remain alongside until July 13. During this time the equipment will be loaded aboard the vessel. Gear will mostly be secured on standard sized pallets including 4, size 300 compressed non-flammable gas cylinders, filled with ultra-high purity Nitrogen gas (UHP N_2).

Brown will arrive in Kodiak on August 1, 2015. Details TBD.

Equipment will be secured on pallets and craned to shore. Pickup by shipping company will commence on Saturday, August 1, 2015.

C. Operations to be Conducted:

After departing Seattle, WA on July 13, 2015, the ship will steam to the first transect (1) near Dixon Entrance and continue science operations until the final transect (15, see map). The ship will then transit to Kodiak, arriving August 1,

2015. On the way to the pier, the ship will stop to collect a surface sample at the Chiniak surface mooring (see appendix).

Due to the weather dependency of many operations, the schedule will be flexible with the order of the stations and transects that are visited. In addition, sampling at stations close to shore and in shipping channels (i.e., Hichinbrook Entrance) will heavily depend on weather conditions and the discretion of the ship's command.

D. Dive Plan

All dives are to be conducted in accordance with the requirements and regulations of the NOAA Diving Program (http://www.ndc.noaa.gov/dr.html) and require the approval of the ship's Commanding Officer. (This statement must remain in all project instructions)

Dives are not planned for this project.

E. Applicable Restrictions

Conditions which preclude normal operations: (List restrictions such as poor weather conditions, equipment failure, safety concerns, unforeseen circumstances, as well as mitigation strategies that might be used).

III. Equipment

A. Equipment and Capabilities provided by the ship

- Navigational systems including high-resolution GPS.
- Underway flow-through seawater system with TSG
- Met/UDAS data systems
- CTD 911 with conductivity and temperature sensors and deck unit
- 12 Niskin bottles rosette
-

- Freezer space (20 cubic feet) for seawater samples (no chemicals).
- Minimum of 2 computers with internet and e-mail access
- Laboratory space with compressed gas cylinder storage space
- Seawater hoses and nozzles to wash nets
- Adequate deck lighting for nighttime operations
- Evaporated/Distilled water for sample analysis
- Ship's crane for loading and/or deploying

B. Equipment and Capabilities provided by the scientists

- CTD 911 with fluorometer, PAR, Oxygen sensors and a 24 bottle rosette (Details TBD)
- SBE 49 plus FastCAT CTD sensor for bongo net deployments (Details TBD)
- 60 and 20 cm bongo net sampling array
- 40 cm hand net sampling array
- 2 Argo floats in pre-installed Argo rack
- Chlorophyll and nutrient sampling equipment
- OA sampling and analytical equipment
- Oxygen sampling and analytical equipment
- Underway Burkolator installed in flow-through system (See Appendix B)

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
   a. Compressed gas cylinders dimensions
      i. Size 30A is approximately 24" x 8" x 8"
      ii. Size 300 is approximately 56" x 10" 10"

Common Name of Material	Qty	Notes	Trained Individual	Spill control
Air	3, size 30A	Non-flammable	Wiley Evans	N/A
Nitrogen	4, size 300 tanks	Non-flammable	Natalie Monacci	N/A
Mercuric Chloride	0.25L	See 'M' below	Natalie Monacci	M
Hydrochloric acid	5 L	See 'A' below	Natalie Monacci	A
Phosphoric acid	2 L	See 'A' below	Natalie Monacci	A
Sulfuric acid	2 L	See 'A' below	Natalie Monacci	A
Sodium hydroxide	1 L	See 'B' below	Natalie Monacci	B
Formalin	250 mL	See 'O' below	Jessica Cross	O
Formalin	20 L	See 'O' below	Caitlin Smoot	O
Ethanol	60 L	See 'O' below	Caitlin Smoot	O
Acetone	8 L	See 'O' below	Caitlin Smoot	O

C. Chemical safety and spill response procedures

A: Acid

- Use proper PPE.
- Ventilate area.
- Neutralize with baking soda (sodium bicarbonate)
- Absorb with cat litter or vermiculite.
- Vacuum or sweep up material and place into suitable disposal container.
- Do not breathe dust.
- Do not get water on spilled substances.

B: Base

- Use proper PPE.
- Ventilate area.
- Neutralize with dilute acid such as HCl if possible.
- Absorb with cat litter or vermiculite.
- Vacuum or sweep up material and place into suitable disposal container.
- Do not breathe dust.
- Do not get water on spilled substances.

M: Mercury

- Pick up and place in a suitable container for reclamation or disposal.
- Sprinkle area with mercury eater.
- Note: Mercuric chloride will be aqueous (7.5% solution)

O: Organics

- Use proper PPE.
- Ventilate area.
- Neutralize with dilute acid such as HCl if possible.
- Absorb with cat litter or vermiculite.
- Vacuum or sweep up material and place into suitable disposal container.
- Do not breathe dust.
- Do not get water on spilled substances.

Inventory of Spill Kit supplies:

Product Name	Amount	Chemicals it is useful against	Amount to clean
Mercury eater	1.8kg	mercuric Chloride/Mercury	.5L
Goggles	1 pair	All	N/A
Plastic Bags	5	All – for used absorbents	Varies
Final Wipes	50	mercuric Chloride/Mercury	N/A
Rubber Gloves	2 pair	All	N/A
Broom	1 ea	All	N/A
Formox	20 oz.	Formalin	N/A
EnPac universal spill kit	1	All	Varies

D. Radioactive Materials

No radioactive isotopes are planned for this project.

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

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:

a. OMAO Data

b. Program Data - 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

B. Responsibilities: Chief Scientist will distribute data to Program Principle Investigators as appropriate.

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 three 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 that 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.

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 e-mail 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 at least 30 days in advance.

E. IT Security

Any computer that will be hooked into the ship's network must comply with the *NMAO 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 these 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 three days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

Foreign National access to the NOAA Ship or Federal Facilities is not required for this project.

VIII. Appendices

Appendix A: Surface Buoy sampling

Three surface instrumentation buoys, which are part of NOAA's Ocean Acidification Program will be visited during RB-15-04 to

1. Characterize ocean acidification (OA) conditions on the U. S. in S.E. Alaska and northern Gulf of Alaska.
2. Conduct inter-calibration measurements near the OA observing assets in the study area, allowing inter-calibration of these autonomous assets with high-quality, ship-based measurements;
3. Provide calibration data needed to develop predictive models for aragonite saturation state, pH, and other important OA indicators based on widely measured parameters such as salinity, temperature, and oxygen concentration;
4. Provide quantitative assessment of phytoplankton, zooplankton, and harmful algal bloom activity in conjunction with OA measurements; and

The three surface buoys are found at

1. Port Conclusion Mooring Site
    a. 56.2688 N, 134.6585 W
    b. Approximate depth is 115 meters
    c. This buoy can be found on NOAA Chart 17331 and is unlabeled with color "Y bl"
2. Sunny Cove, Resurrection Bay Mooring Site:
    a. 59.9N 149.33W
    b. Approximate depth is 51 meters
    c. This buoy is not labeled on NOAA chart 16682.

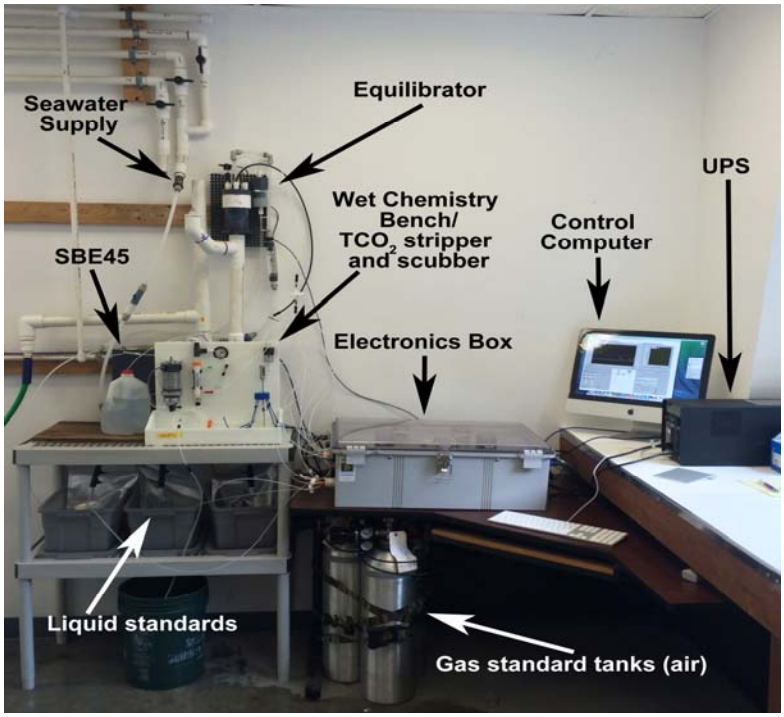
3. Chiniak Bay Mooring Site
    a. 57.6967N 152.3133W
    b. Approximate depth is 143 meters
    c. This buoy can be found on NOAA Chart 16595 and is labeled "NOAA-UAF"

Appendix B: Underway System: Burkolator

The Burkolator (pictured below) is a system that measures carbon dioxide from a continuously flowing seawater stream. The components include: Equilibrator, SBE45 Thermosalinograph, wet chemistry bench with TCO2 stripper and scrubber, electronics box, control computer, uninterruptible power supply, gas standard bottles (compressed air) and liquid standard bags.

A. Requirements:

1. Constant seawater supply from seachest that is equipped with SBE37 or similar temperature sensor at seawater intake. We will step whatever plumbing connections (ideally 1" NPT) to 1/2" nylon tubing.
2. Drain for constant seawater supply. Effluent from the equilibrator will flow from 1" tubing (or similar). A sink would be great as a place to drain.
3. A GPS stream from the bridge.
4. A copy of ship UDAS with met and seawater intake temperature data.
5. Power: clean 120V.
6. An atmospheric sample line will need to be run from the system to a high point on the vessel that is least likely to be impacted by engine exhaust.
7. 6-8 feet of bench space including floor space to mount gas standard bottles. Some components (equilibrator, optics board) can be mounted vertically on the bulkhead if there is unistrut.
8. Some time with the survey technician during installation to provide guidance with connections to appropriate seawater supply from ship, connection with the ship GPS feed, and running of the atmospheric sample line.



Appendix C: Station List

#	Station Name	Line	Line Name	Latitude	Longitude	Notes
A	*SEAK*		*SEAK surface buoy*	*56.273*	*-134.657*	*See Appendix*
B	*GAKOA*		*GAKOA surface buoy*	*59.912*	*-149.349*	
C	*Chiniak*		*Chiniak surface buoy*	*57.707*	*-152.297*	
1	DE1	1	Dixon Entrance	53.959	-134.706	US only
2	DE2	1	Dixon Entrance	54.169	-134.334	
3	DE3	1	Dixon Entrance	54.439	-133.852	
4	DE4	1	Dixon Entrance	54.573	-133.612	
5	DE5	1	Dixon Entrance	54.721	-133.347	
6	DE6	1	Dixon Entrance	54.838	-133.135	
7	DE7	1	Dixon Entrance	54.879	-133.062	
8	DE8	1	Dixon Entrance	54.885	-133.051	
9	POW1	2	Prince of Wales	55.827	-134.305	
10	POW2	2	Prince of Wales	55.798	-134.356	
11	POW3	2	Prince of Wales	55.764	-134.416	
12	POW4	2	Prince of Wales	55.731	-134.472	
13	POW5	2	Prince of Wales	55.621	-134.664	
14	POW6	2	Prince of Wales	55.503	-134.870	
15	POW7	2	Prince of Wales	55.377	-135.090	
16	POW8	2	Prince of Wales	55.220	-135.360	
17	CST1	3	Chatham Strait	56.177	-134.321	
18	CST2	3	Chatham Strait	56.179	-134.395	
19	CST3	3	Chatham Strait	56.181	-134.458	
20	CST4	3	Chatham Strait	56.183	-134.558	
21	CST5	3	Chatham Strait	56.185	-134.625	
23	SEC0	4	Southeast (SE) C	56.775	-135.491	
24	SEC5	4	Southeast (SE) C	56.733	-135.618	
25	SEC10	4	Southeast (SE) C	56.690	-135.745	
26	SEC20	4	Southeast (SE) C	56.606	-135.998	
27	SEC30	4	Southeast (SE) C	56.521	-136.252	
28	XS1	5	Cross Sound	58.112	-136.532	
29	XS2	5	Cross Sound	58.130	-136.560	
30	XS3	5	Cross Sound	58.157	-136.588	
31	XS4	5	Cross Sound	58.175	-136.617	
32	SEM-2.5	6	Southeast (SE) M	58.271	-136.873	
33	SEM0	6	Southeast (SE) M	58.250	-136.947	
34	SEM2.5	6	Southeast (SE) M	58.232	-137.007	

35	SEM5	6	Southeast (SE) M	58.210	-137.083	
36	SEM10	6	Southeast (SE) M	58.171	-137.218	
37	SEM20	6	Southeast (SE) M	58.092	-137.490	
38	SEM30	6	Southeast (SE) M	58.013	-137.762	
39	YBC0	7	Yakutat Bay	59.492	-139.883	
40	YBC10	7	Yakutat Bay	59.353	-140.067	
41	YBC20	7	Yakutat Bay	59.214	-140.250	
42	YBC30	7	Yakutat Bay	59.075	-140.433	
43	YBC40	7	Yakutat Bay	58.936	-140.617	
44	YBC50	7	Yakutat Bay	58.797	-140.800	
45	IB1	8	Icy Bay	59.927	-141.518	
46	IB2	8	Icy Bay	59.893	-141.577	
47	IB3	8	Icy Bay	59.860	-141.637	
48	IB4	8	Icy Bay	59.790	-141.754	
49	IB5	8	Icy Bay	59.721	-141.870	
50	IB6	8	Icy Bay	59.651	-141.982	
51	IB7	8	Icy Bay	59.511	-142.198	
52	IB8	8	Icy Bay	59.233	-142.617	
53	CUR1	9	Copper River	60.174	-145.064	
54	CUR2	9	Copper River	60.141	-145.123	
55	CUR3	9	Copper River	60.107	-145.182	
56	CUR4	9	Copper River	60.038	-145.294	
57	CUR5	9	Copper River	59.967	-145.406	
58	CUR6	9	Copper River	59.899	-145.516	
59	CUR7	9	Copper River	59.757	-145.739	
60	CUR8	9	Copper River	59.545	-146.060	
61	HBE1	10	Hichinbrook Entrance	60.296	-146.669	Ship's choice
62	HBE2	10	Hichinbrook Entrance	60.296	-146.727	PWS Safety Area
63	HBE3	10	Hichinbrook Entrance	60.296	-146.800	
64	HBE4	10	Hichinbrook Entrance	60.297	-146.880	
65	HBE5	10	Hichinbrook Entrance	60.297	-146.905	
66	MS1	11	Montague Strait	59.953	-147.931	
67	MS2.5	11	Montague Strait	59.937	-147.884	
68	MS4	11	Montague Strait	59.920	-147.833	
69	GAK1	12	Gulf of AK	59.845	-149.467	
70	GAK2	12	Gulf of AK	59.692	-149.327	
71	GAK3	12	Gulf of AK	59.553	-149.188	
72	GAK4	12	Gulf of AK	59.408	-149.048	
73	GAK5	12	Gulf of AK	59.262	-148.908	

74	GAK6	12	Gulf of AK	59.117	-148.770	
75	GAK7	12	Gulf of AK	58.972	-148.630	
76	GAK8	12	Gulf of AK	58.792	-148.490	
77	GAK9	12	Gulf of AK	58.680	-148.350	
78	GAK10	12	Gulf of AK	58.542	-148.212	
79	GAK11	12	Gulf of AK	58.388	-148.072	
80	GAK12	12	Gulf of AK	58.243	-147.933	
81	GAK13	12	Gulf of AK	58.098	-147.793	
82	GAK14	12	Gulf of AK	57.943	-147.648	
83	GAK15	12	Gulf of AK	57.792	-147.500	
84	HH193	13	Kodiak - 193	58.003	-152.025	
85	HL193	13	Kodiak - 193	57.773	-151.611	
86	HP193	13	Kodiak - 193	57.545	-151.186	
87	HT193	13	Kodiak - 193	57.315	-150.764	
88	HX193	13	Kodiak - 193	57.081	-150.348	
89	CI1	14	Cook Inlet	59.250	-151.986	
90	CI2	14	Cook Inlet	59.152	-152.305	
91	CI3	14	Cook Inlet	59.055	-152.621	
92	CI4	14	Cook Inlet	58.957	-152.935	
93	CI5	14	Cook Inlet	58.866	-153.232	
94	GT169	15	Shelikof - 169	57.355	-156.083	15 is last
95	GV169	15	Shelikof - 169	57.240	-155.878	
96	GX169	15	Shelikof - 169	57.125	-155.659	
97	GZ169	15	Shelikof - 169	57.011	-155.440	
98	HB169	15	Shelikof - 169	56.896	-155.223	
99	HD169	15	Shelikof - 169	56.781	-155.005	
100	HF169	15	Shelikof - 169	56.666	-154.789	

Notes:

1. The proximity to the surface buoy for calibration sampling is the ship's decision.
2. Please let us know if the Dixon Entrance stations are not in US waters. We will not be sampling in Canadian waters. We can adjust these locations as needed.
3. Two new stations have been added to the previously sampled SEM transect (Line 6). We would like station SEM-2.5 to be as close to shore as the ship will allow.
4. The Hichinbrook Entrance transect station locations can be adjusted based on the ship's decision.
5. We will need to do the Shelikof Strait transect last to allow sufficient time to analyze samples on the transit back to Kodiak.