Date: 4-8 June 2014
Ship: R/V Ka'imikai-o-Kanaloa, University of Hawaii
Master of the Vessel: Don Jack
Cruise ID: KOK1405
Chief Scientist: Benedetto Barone
Second Scientist in charge: Tara Clemente
OTG Marine Technicians: David Hashisaka, Justin Smith, Nick Mathews

Ka'imikai-o-Kanaloa phone number: 842-9818, cell 808-690-5393, satellite 011-870-773-233658
Marine Center phone number: 842-9813
Benedetto Barone: 808-389-9939
Tara Clemente: 808-389-0544

Loading: June 3, 2014 @ 1100
Departure: June 4, 2014 @ 900
Arrival: June 8, 2014 @ 0800

1.0 SCIENTIFIC OBJECTIVES

The objective of the cruise is to maintain a collection of hydrographic and biogeochemical data at the Hawaii Ocean Time-series (HOT) station. Station ALOHA, is defined as a circle with a 6 nautical mile radius centered at 22° 45'N, 158°W. This is the main HOT station and will be occupied throughout the cruise. The summary schedule is as follows:
3 June    Ship loading at 1100.
4 June    Depart from Snug harbor at 900 hrs. Science personnel on-board by 800
          Safety briefing, orientation meeting 1000.
4 June    Station SWAC 3,2, and 1: CTD operations.
5-7 June  Station ALOHA operations.
8 June    Arrive back to Snug Harbor. Offload.

Whenever pumping of the ship’s tanks is needed, it must be conducted outside the circle that defines station ALOHA (Sect. 1.0). To avoid disruptions in the schedule, this operation should be coordinated with the chief scientists and we will allocate three times a day when this operation can occur.

2.0 SCIENCE PERSONNEL

<table>
<thead>
<tr>
<th>Participant</th>
<th>Title</th>
<th>Affiliation</th>
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</thead>
<tbody>
<tr>
<td>Benedetto Barone (M)</td>
<td>Post-Doc</td>
<td>UH/CMORE</td>
</tr>
<tr>
<td>Bob Bidigare (M)</td>
<td>Scientist</td>
<td>UH/CMORE</td>
</tr>
</tbody>
</table>
Maxine Builder (F)  Guest   CFR
Glenn Carter (M)  Scientist  UH/SOEST
Tara Clemente (F)  Research Associate UH/CMORE
Christina Comfort (F)  Research Associate UH/SOEST
Ken Doggett (M)  Research Associate UH/CMORE
Laurie Garret (F)  Guest   CFR
Anne Gasc (F)   Scientist  UH/CMORE
Stuart Goldberg (M)  Post-Doc  UH/CMORE
Eric Grabowski (M)  Research Associate UH/CMORE
Florian Hillenhagen (M)  Graduate student UH/SOEST
Gavin Mura (M)   Intern   UH/CMORE
Andrei Natarov (M)  Assistant Researcher UH/IPRC
Sarah Searson (F)  Research Associate UH/CMORE

(17 science personnel: 10 male and 7 female)

3.0 OPERATIONAL PLANS

3.1 SWAC Station sampling:

SWAC 3 (Intake site; 21.2231, -157.8656; depth 545 m),

SWAC 2 (Down slope; 21.2782, -157.8725; depth 175 m) and

SWAC 1 (Diffuser site; 21.2804 N, 157.8713 W; depth 105 m)

*Shipboard operations:* (3.1) CTD operations, (3.2) sediment traps, (3.3) optics casts, (3.4) HyperPRO, (3.5) VMP, (3.6) diaphragm pump, (3.7) net tows

*Underway/continuous operations:* (3.8) ADCP, thermostalinograph, pCO2 system, fluorometry, and meteorology

3.1 CTD operations
Vertical profiles of temperature, conductivity and dissolved oxygen will be made with an instrument package consisting of a Sea-Bird CTD attached to a 24-place rosette with 12 liter Bullister sampling bottles. We will need the ship’s CTD winch and crane for these operations. Water samples for biogeochemical measurements will be collected on each cast.

There will be two additional instrument to be included with the OTG CTD package: an ISUS (real time, chemical free sensor for measuring nitrate, requires 0.625 amps at 12V); and a lowered ADCP, to be mounted on the bottom of the rosette (internal batteries and internal data logging).

3.2 Sediment trap array
One floating sediment traps will be deployed at a location within Station ALOHA, to be determined enroute to ALOHA by local current conditions (see the Station ALOHA Nowcast/Forecast at http://aloha.manoa.hawaii.edu under “Operations”). The array will be deployed from the stern, using the A-frame and Sea-Mac winch. Power requirement for the winch is 440 VAC, three phase at 10 amps. After deployment we request that the Bridge verify that the radio transmitters are functioning and directionally correct. The array will drift and be recovered on a subsequent cruise on the R/V Kilo Moana.
(June 16-27). The array is equipped with 2 ARGOS satellite transmitters (platform #’s XXXX, XXXXX), 2 strobe lights, and 2 radio transmitters (channel XX, XXX MHz). Daily positions of the array shall be transmitted by email directly to the ship (argosfix@satellite-email.com, password: argosfix), therefore the ship will not need to keep within site of the array until the time of the recovery. Assistance from the bridge is requested in plotting the drift track of the array. We request the use of the ship's radio direction finder for locating the array before recovery.

3.3. ACS/AC9/FRRf/LISST
An optical package including a Wet Labs AC9 that measures water column spectral absorption and attenuation at nine wavelengths, a Chelsea Fast Repetition Rate Fluorometer (FRRf), a SeaBird Seacat with temperature, conductivity, fluorometer, and pressure sensors, and a LISST particle size and distribution analyzer will be deployed two times daily. Each deployment will consist of two up and two down profiles to a target depth of 200 m at a constant speed of 10 m/min during both the downcast and upcast. An instrument soaking period at just below the surface will be required between the two profiles. The A-frame and capstan will be needed for this operation.

3.4. Hyperpro
Daily deployment of Satlantic radiometer to characterize irradiance and radiance. The Hyperpro is a profiling unit with one up-looking and one down-looking hyperspectral radiometer, a WET Labs ECO-BB2F triplet (measuring Chlorophyll-a fluorescence and backscattering in the blue and red wavelengths), temperature and conductivity sensors. This instrument also incorporates a ship mounted surface radiometer. The Hyperpro will be deployed from the stern through a small block hung from the A-frame. The instrument is hand-lowered and retrieved with assistance from the winch.

3.5 VMP:
Deploy a loosely tethered vertical microstructure profiler from the stern of the ship. The instrument is free falling and has its own cable and its own winch. On descent the instrument needs to be effectively decoupled from the ship by having some loose cable in the water. On the ascent the winch hauls the instrument in, so the cable is taut. The ship needs to be moving ahead slowly to prevent the cable from going under the ship, about 0.5 knts through the water is reasonable. The instrument is light (<40 kg). A slip line could be used for launching, or else a quick release hook. For recovery, a line through a block on the A-frame can be used to haul it out of the water. This can be done with an air-tugger or by hand. The winch requires a 208-220 V power source, and its footprint is approximately 30” x 30”. In the past we have put the winch as close to the transom as possible. Another option is to set the winch forward and use a hanging snatch block for the ascent phase. Each deployment consists of 3-4 casts and lasts about 1 hour.

3.6 Diaphragm pump
A small compressed air driven pump (P100 Wilden Advanced plastic 1/2” pump) which uses up to 125 psi compressed air to pump seawater through 5/8” OD HDPE tubing. The tubing extends down to a depth of 100 m and is tied at 5 m intervals to a line running through the A-frame. This backdeck operation typically last 45 min and requires the use of the ships compressed air supply, the A-frame, a line with a weight on the end.

3.7 Net Tows:
Deployment of the net tows from the stern. The net will be deployed by hand for approximately 1-2 hours one to two times daily. This operation may require the use of the A-frame and capstan.
3.8 Thermosalinograph, pCO2 system, Fluorometer, and meteorological system
The ship’s thermosalinograph, pCO2 system and fluorometer sampling the uncontaminated seawater supply system will be in operation during the duration of the cruise while the ship is outside of Snug Harbor. The ship’s meteorological system shall be in operation throughout the cruise. Access to real-time underway data through the ship’s network will be required. The OTG technicians will be in charge of the thermosalinograph, pCO2 system, Fluorometer, and meteorological suite operations.

3.9 We also request that OTG group initiate the shell script to automatically send the ships coordinates approximately hourly by email to poulos@soest.hawaii.edu and lfujieki@soest.hawaii.edu. This will be important to cross-calibrate the instrumentation in the water (sea-gliders and floats).

4.0. EQUIPMENT

4.1 The science party shall be bringing the following
1. One 20 ft. laboratory van (Karl Flow Cytometry)
2. One 20 ft. laboratory van (#23) with assorted equipment for radioisotope and general
3. Vertical microstructure profiler with cable and winch
4. All required chemicals and isotopes
5. Large vacuum waste containers
6. Two liquid nitrogen dewars
7. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights
8. Polypropylene line
9. Sediment traps and crosses
10. Lowered ADCP
11. Hyperpro and other optical measuring instruments.
12. Oxygen titration system
13. Plankton nets and towing lines
14. Desktop and laptop personal computers
15. Assorted tools
16. All required sampling bottles
17. Deck incubation system (big blue + small blue)
18. Pertinent MSDS
19. Optical package
20. LADCP
21. Quick release hook
22. Stand up incubator (temperature controlled)

4.2 We will need the use of the following ship's equipment:
1. OTG’s 24-place rosette, and 24 12-l water sampling bottles
2. CTD Instrument package
3. A-frame
4. A-frame block assembly
5. Caley winch and crane with conducting wire for CTD
6. Electric power for winches (440 VAC, 3 phase, 60 Amp breaker) and vans (208 VAC single phase at 60 amps for lab van and VMP, 110 VAC 10 amps for equipment van)
7. Radio direction finder
8. Space on hangar and upper deck for two laboratory vans
9. Space on upper deck for incubators
10. Hand-held VHF transceivers
11. Precision depth recorder
12. Shackles, sheaves, hooks and lines
13. Shipboard Acoustic Doppler Current Profiler
14. Thermosalinograph, pCO2 system, and Fluorometer
15. Meteorological suite
16. Copy machine
17. Grappling hooks and line
18. Navlink2 PC or equivalent
19. Running fresh water and seawater, hoses
20. Electronic mail system
21. GPS system
22. Uncontaminated seawater supply
23. Small capstan (~ 10 m/min)
24. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, pCO2 and access to real-time data through the network
25. OTG’s 24-place rosette, and 24 12-l water sampling bottles (to be used as spare)
26. 1000 lb weight
27. Large Sea-Mac winch (Mod. 1025 EHS). 60 Amp Hubbel plug/connector (440 VAC, 3 phase, 60 Amp breaker)
28. Kevlar line
29. Monitor in Rock Lab displaying ship coordinates and GMT
30. Remote CTD dbar pressure display in the winch operator area
31. Air-tugger
32. c-star transmissometer

5.0 CRUISE SCHEDULE
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<td>Net tow</td>
<td>VMP cast</td>
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June 6th: Sunrise 0546, Sunset 1915
## CTD Casts

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<th>Depth</th>
<th>Sample</th>
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<td>0100</td>
<td>500 m</td>
<td>Open</td>
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<tr>
<td>0300</td>
<td>500 m</td>
<td>Nutrients in the upper 500 m AA nuts, DOC, Silicate depths: 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, 400, 420, 440, 460, 480</td>
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<tr>
<td>0600</td>
<td>500 m</td>
<td>Base of the nutricline LLN, Phosphate, FCM, AG, HPLC, KB@25,75,DCM depths: 5+25+45+75+(80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160, 165) +175+200</td>
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<tr>
<td>0900</td>
<td>500 m</td>
<td>Nutrients in the upper 500 m AA nuts, DOC, Silicate depths: 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, 400, 420, 440, 460, 480</td>
</tr>
<tr>
<td>1200</td>
<td>1000 m</td>
<td>calibration cast (O2, fls) x2 + core cast x1 (PC/PN, PPO4, HPLC, ATP) + FDOM EEM depths: 5, 25, 45, 75, 100, 125, 150, 175 + (200, 300, 400, 500, 750, 1000)</td>
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<td>1500</td>
<td>500 m</td>
<td>Nutrients in the upper 500 m AA nuts, DOC, Silicate depths: 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, 400, 420, 440, 460, 480</td>
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<tr>
<td>1800</td>
<td>500 m</td>
<td>Base of the nutricline LLN, Phosphate, FCM, AG, HPLC depths: 5+25+45+75+(80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160, 165) +175+200</td>
</tr>
<tr>
<td>2200</td>
<td>500 m</td>
<td>Nutrients in the upper 500 m AA nuts, DOC, Silicate depths: 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, 400, 420, 440, 460, 480</td>
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## CTD Casts

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<td>S1C01</td>
<td>500 m</td>
<td>SWAC3: DO, temp, DIC/Alk, nuts, Chl a, N2O/CH4, FCM (2@5, 25, 45, 75, 100, 150, 300, 500 m)</td>
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<td>S1C02</td>
<td>150 m</td>
<td>SWAC2: DO, temp, DIC/Alk, nuts, Chl a, N2O/CH4, FCM (2@5, 25, 45, 75, 100, 150 m)</td>
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<td>S1C03</td>
<td>95 m</td>
<td>SWAC1: DO, temp, DIC/Alk, nuts, Chl a, N2O/CH4, FCM (2@5, 25, 45, 75, 100 m)</td>
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<td><strong>5 June</strong></td>
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<tr>
<td>S2C01</td>
<td>500 m</td>
<td>LLN, Phosphate (18 depths) + KB@25,75, DCM FCM&amp;FCM euk (18 depths + 5,25,45,75,175) AG 600mL@(5,25,45,75,100,125,150,200) HPLC 2L@18depths</td>
<td>24</td>
</tr>
<tr>
<td>S2C02</td>
<td>500 m</td>
<td>AA nuts, DOC, Silicate (24 depths)</td>
<td>24</td>
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<tr>
<td>S2C03</td>
<td>1000 m</td>
<td>Chl a (8 std depths), NO3 (750,500,300) O2 (1000,750,500,300,200,100,25,5) EEM 40mL@(5,25,45,75,100,125,150,175,200,300,400,500) AG 600mL@(5,25,45,75,100,125,150,200) AG 1L@1000</td>
<td>14</td>
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<td>S2C04</td>
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<td>AA nuts, DOC, Silicate (24 depths)</td>
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<td>S2C05</td>
<td>500 m</td>
<td>LLN, Phosphate (18 depths) FCM&amp;FCM euk (18 depths + 5,25,45,75,175) AG 600mL@(5,25,45,75,100,125,150,200) HPLC 2L@18depths</td>
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<td>AA nuts, DOC, Silicate (24 depths)</td>
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<td>S2C09</td>
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<td>AG 2Niskin@5m</td>
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<td>S2C10</td>
<td>500 m</td>
<td>LLN, Phosphate (18 depths) + KB@25,75, DCM DNA&amp;RNA 4L@90,100,110,120,130,140,150,160 AG 600mL@(5,25,45,75,100,125,150,200) FCM&amp;FCM euk (18 depths + 5,25,45,75,175) HPLC 2L@18depths</td>
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S2C11  500 m  AA nuts, DOC, Silicate (24 depths)  24

S2C12  1000 m  PC/PN, HPLC, ATP, PPO4 (8 std depths + DCM + part. max)
             EEM 40mL@(5,25,45,75,100,125,150,175,200,300,400,500)
             AG 600mL@(5,25,45,75,100,125,150,200)

S2C13  500 m  AA nuts, DOC, Silicate (24 depths)
           DNA&RNA 4L@(80,140,200,260,320,380,440,480)

S2C14  500 m  LLN, Phosphate (18 depths)
           AG 600mL@(5,25,45,75,100,125,150,200)
           FCM&FCM euk (18 depths + 5,25,45,75,175)
           HPLC 2L@18depths

S2C15  500 m  AA nuts, DOC, Silicate (24 depths)  24

7 June
S2C16  500 m  SG 16 Niskin @ 5m
           AG 600mL@(5,25,45,75,100,150,200)

S2C17  500 m  AA nuts, DOC, Silicate (24 depths)  24

S2C18  500 m  LLN, Phosphate (18 depths) + KB@25,75,DCM
           DNA&RNA 4L@(90,100,110,120,130,140,150,160)
           FCM&FCM euk (18 depths + 5,25,45,75,175)
           AG 600mL@(5,25,45,75,100,125,150,200)
           HPLC 2L@18depths

S2C19  500 m  AA nuts, DOC, Silicate (24 depths)  24

S2C20  1000 m  Chl a (8 std depths), NO3 (750,500,300)
             O2 (1000,750,500,300,200,100,25,5)
             EEM 40mL@(5,25,45,75,100,125,150,175,200,300,400,500)
             AG 600mL@(5,25,45,75,100,125,150,200)

S2C21  500 m  AA nuts, DOC, Silicate (24 depths)
           DNA&RNA 4L@(80,140,200,260,320,380,440,480)

S2C22  500 m  LLN, Phosphate (18 depths)
           FCM&FCM euk (18 depths + 5,25,45,75,175)
           AG 600mL@(5,25,45,75,100,125,150,200)
           HPLC 2L@18depths
6.0 CRUISE OBJECTIVES

**Overall cruise objective:** Estimate the vertical turbulent diffusion of organic and inorganic compounds in the upper 500 m of the water column. Assess the effects of these diffusive fluxes on the planktonic community with a focus on the photoautotrophic organisms.

**Individual cruise objectives**

1. **Surface mixing**
   Measurements of turbulent kinetic energy dissipation rates from vertical microstructure profiles (upper 500 m). High resolution measurements of horizontal shears (leading to Kelvin Helmotz instabilities) from lowered ADCP. Estimate of the timescale of surface mixing from measurements of the concentration of pigments of the Xanthophyll cycle and hydrogen peroxide in the mixed layer using a diaphragm pump at noon.

2. **Nutrient and organic matter diffusion**
   Estimate inorganic nutrient and organic matter diffusion from turbulent diffusivity and high resolution sampling for compound concentrations.

3. **Export**
   Sediment traps deployed at several depths for about 20 days

4. **Particle accumulation due to gradients of vertical diffusivity**
   Optical assessment of particle accumulation associated with strong vertical gradients in eddy diffusivity.

5. **Phytoplankton community at the nutricline**
   Estimates of the vertical changes in the algal community in the layer of maximal diffusion of inorganic nutrients. High resolution measurements of pigment concentration and flow cytometry. Measurements of photosynthetic efficiency with variable fluorescence.

6. **Heat content of the particulate matter**
   Use of net tows to collect particulate material in different size fractions to estimate their caloric content.

7. **Photoheterotrophic metabolism in Prochlorococcus**
   On-deck incubations and flow-sorting to estimate leucine assimilation.

8. **Site assessment for the sea water air conditioning project**