# Hawaii Ocean Time-series
# HOT-260 Operational Cruise Plan V2

Cruise ID: KM1406
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Captain Jay Chavez
Chief Scientist: Brett Updyke, University of Hawaii
OTG Marine Technicians: Jeff Koch, Justin Smith, and Steve Tottori

*Kilo Moana phone number: 842-9817, cell # 864-0065, satellite # 011-870-773234249*
*Marine Center phone number: 842-9813*

Loading: 12 February, 2014 @ 0900
Departure: 13 February, 2014 @ 0900 (Science personnel on board by 0800)
Arrival: 17 February, 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) stations. Four stations will be occupied during the cruise, in the following order:

1) Station 1, referred to as Station Kahe, is located at 21° 20.6'N, 158° 16.4'W and will be occupied on February 13th for about 2 hours.
2) Station 2, referred to as 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 February 14th-16th.
3) Station 52, the site of WHOTS-10 Mooring (anchor position 22° 40.12'N 157° 57.01'W) will be occupied on February 16th for about one hour.
4) Station 6, referred to as Station Kaena, is located off Kaena Point at 21° 50.8'N, 158° 21.8'W and will be occupied on February 16th for about 2 hours.

## 1.1 SCIENTIFIC OPERATIONS

| Station | Activities |
|---|---|
| Kahe (sta. 1) | Weight Cast, Hyperpro cast, CTD cast (1000 m) |
| ALOHA (sta. 2) | Sediment traps, gas array, net tows, CTD operations, primary productivity measurements, ACS/AC9/FRRf, misc. experiments. |
| WHOTS mooring station (Sta. 52) | One CTD cast (yo-yo to 200 m), surface instrument intercomparisons. |
| Kaena (sta. 6) | One CTD cast (near bottom) |
| Underway/continuous | ADCP, thermosalinograph, pCO2 system, fluorometry, and meteorology. |

## 2.0. SCIENCE PERSONNEL

| Participant | Title | Affiliation |
|---|---|---|
| Dan Sadler | Research Associate | UH |
| Lance Fujieki | Research Associate | UH |
| Susan Curless | Research Associate | UH |
| Adriana Harlan | Research Associate | UH |
| Brett Updyke | Research Associate | UH |
| Blake Watkins | Marine Engineer | UH |
| Stuart Goldberg | Postdoctoral Researcher | UH |
| Jefrey Snyder | Marine Technician | UH |
| Joseph Gum | Research Associate | UH |
| Cameron Fumar | Research Associate | UH |
| Daniel McCoy | Research Associate | UH |
| Damion Rosbrugh | Undergraduate Student | UH |
| Kapono Gaughen | Undergraduate Student | UH |
| Brenner Wai | Technician | UH |
| William McQuiston | Intern | UH |
| David Ho | Professor | UH |
| Ben Hickman | Technician | UH |
| Eugene Gorman | Research Associate | LDEO |
| Jim Foley | Marine Educator | UH |
| Kimberlee Stewart | Teacher | Kapaa High School |
| Elizabeth Eubanks | Teacher | Pope High School |
| Robyn Ehrlich | Teacher | Kihei Public Charter School |
| Jeff Koch | Marine Technician | OTG |
| Justin Smith | Marine Technician | OTG |
| Steve Tottori | Marine Technician | OTG |

## 3.0. SUMMARY SCHEDULE

| | |
|---|---|
| 06 February | Pre-cruise planning meeting 1330 hrs. |
| 12 February | Ship loading at 0900 hrs. |
| 13 February | Depart from Snug harbor at 0900 hrs. **Science personnel on-board by 0800.** |
| 13 February | Station 1 Kahe Pt. operations. |
| 14-16 February | Station ALOHA operations, Station 52 CTD yo-yo cast, Station Kaena |
| 17 February | Arrive at Snug Harbor. Full offload. |

## 4.0. OPERATIONAL PLANS

### 4.1. Station Kahe (21°20.6'N, 158°16.4'W)

A 1300 lb. weight-test cast, one CTD cast to 1000 m, a Hyperpro cast (Sect. 4.2.7), and a hand-deployed Niskin cast to 20 m will be conducted at this location on February 13$^{th}$. The A-frame and trawl winch will be required for these operations.

4.2. Station ALOHA (22°45'N, 158°W with 6 nm radius)

4.2.1. Upon arrival to Station ALOHA, the sediment traps will be deployed (Sect. 4.2.2). After the sediment trap deployment is complete, two net tows (Sect. 4.2.6) and one 1000 m CTD cast will be conducted before deploying the Primary Productivity array (Sect. 4.2.3). These operations will be followed by a near-bottom CTD cast.

4.2.2. Sediment trap array deployment

Upon arrival to Station ALOHA, the floating sediment traps will be deployed at a location within Station ALOHA, to be determined enroute to ALOHA considering nowcast and forecast currents and weather information. 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 for about 53 hours before recovery. The array is equipped with 2 ARGOS satellite transmitters (platform #'s 3028, 60482), 2 strobe lights, and 2 radio transmitters (channel 68: 156.425 MHz). Daily positions of the array shall be transmitted by email directly to the ship (argosfix@km.soest.hawaii.edu, 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.

After deployment of the sediment trap array, the ship shall perform two net tows and then continue with CTD cast operations to prepare water for the Primary Productivity Array and other experiments.

4.2.3 Primary Production experiment

Samples for the primary productivity experiment will be collected from Station 2 CTD cast 1. Before dawn (sunrise 0710 hrs on February 14$^{th}$), a free drifting incubation array will be deployed from the stern. We request the use of the A-frame for this operation and will also use the Sea-Mac winch. The array is equipped with two ARGOS satellite transmitters (platform #'s 60484, 84857 emailing positions to argosfix@km.soest.hawaii.edu, password: argosfix), strobe lights and a radio transmitter (channel 74: 156.725 MHz). The **ship shall keep within site of the array** while performing CTD operations for the last 6 hours of the approximately 12-hour time the array will be in the water unless the array drifts outside of the ALOHA circle. If the array drifts out of the circle, the ship should return inside the circle to conduct CTD casts, and the monitoring of the array will be coordinated with the watch leader. The array will be recovered just at sunset (1822 hrs). CTD operations shall continue after recovery.

All radioactive waste generated by the experiment shall be returned to the University of Hawaii. Only qualified personnel shall handle radioactive material.

4.2.4. Water column measurements

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 A-frame and winch for these operations. Water samples for biogeochemical measurements will be collected on each CTD cast. The cast after the deployment of the Primary Productivity Array shall be made to the near bottom (approximately 4740 m). Following this cast, a series of 1000-m casts shall be made continuously every 3 hours for a 36-hour period. It is highly desired that this burst sampling be done without interruption and we request the ship to maintain position within the study area for that period of time, and repositioning to the center of the Station before each cast whenever possible.

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 scientist or the watch leaders **(Jefrey Snyder, Susan Curless)**.

4.2.5. Gas Array deployment

A second free drifting incubation array will be deployed on the morning of December 21st at Station ALOHA. Samples for the gas array will be collected from Station 2 CTD cast 8. We request the use of the A-frame for this operation and will also use the Sea-Mac winch. The array is equipped with two ARGOS satellite transmitters (platform #'s 60484, 84857 emailing positions to argosfix@km.soest.hawaii.edu, password: argosfix), strobe lights and a radio transmitter (channel 74: 156.725 MHz). The ship will **not** need to keep within sight of the array until the time of the recovery, approximately 25 hours after its deployment. Assistance from the Bridge is requested in plotting the drift track of the array.

4.2.6. Zoo net tows

A plankton net will be deployed from the stern and shall be towed for half-hour periods. Half-hour periods are scheduled around noon and midnight on the second and third days (see schedule) for a total of six slots. The A-frame and capstan will be needed for this operation. B. Watkins will be in charge of these operations.

4.2.6.1 Surface hand net tow

Surface net tows are hand-deployed off the stern for about 15-20 minute periods. One hand net tow is scheduled for 1500 on June 15th. We request that the ship remain stationary during this tow.

4.2.7. Hyperpro

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. At 1400 hours on the first, second and fourth days of the cruise, the Hyperpro will be deployed from the stern through a small block hung from the A-frame. The instrument is hand-lowered and retrieved. Each deployment will consist of three profiles before the instrument is retrieved.

4.2.8. 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 during the cruise.

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 small capstan will be needed for this operation.

4.2.9. Automated Trace Element Sampler (ATE)

On the morning of February 15th, the ATE will be hand deployed off the back deck to a depth of 10 m to collect at Trace Metal Free Sample. The ATE will be recovered after 30 minutes in the water. The ATE is approximately 1' tall and 4'' in diameter, weighting 5 lbs.

**If the ship has been stationary at ALOHA for previous cruise activities, it is requested that the ship steams approximately 10-15 minutes up current from current position prior to each ATE deployment to limit contamination of the trace metal sample from the ship's hull.**

4.3 Gas Array and floating Sediment Trap recovery

In the early morning of February 16th, the ship shall transit for the recovery of the Gas Array. The A-frame and the Sea-Mac winch will be needed to retrieve the Gas Array. After the array is recovered, the ship shall transit to recover the floating sediment trap array. After the array is recovered, the ship shall transit to Station ALOHA for an AC9/FRRf cast. After the AC9/FRRf cast, the ship shall

transit to Station 52 to conduct a 200 m yo-yo cast (Sect. 4.4.1) and surface instrument intercomparisons (Sect. 4.4.2).

4.4 Station 52 - WHOTS-10 Mooring

The anchor position of the WHOTS-10 mooring is 22° 40.12'N 157° 57.01'W. The watch circle of the buoy is about 2 nautical miles. Generally, the buoy stays on the edge of the watch circle. The buoy can be detected via radar in good weather conditions but is harder to detect with larger sea states.

4.4.1 CTD yo-yo cast (subsurface instrument intercomparison)

One 200-m CTD yo-yo cast with at least 5 full cycles will be conducted near the WHOTS buoy on February 16th for subsurface instrument intercomparison. This cast should be conducted downwind, down current, and about 200 m from the buoy.

4.4.2 Surface instrument intercomparison

While on station, the ship's meteorological system shall be in operation for surface instrument intercomparisons with the WHOTS buoy. If the buoy is located outside the circle that defines Station ALOHA, after the yo-yo cast is complete the ship shall transit to Station ALOHA to conduct a Hyperpro cast. Once the Hyperpro cast is complete, the ship shall transit to Station Kaena.

4.5 Station Kaena (21° 50.8'N, 158° 21.8'W)

A near-bottom CTD cast (~2500 m) will be conducted at this location in the evening of February 16th. Once the CTD cast is complete, the ship shall return to Snug Harbor.

4.6 Seaglider Operations

There are currently no seagliders profiling at or near Station ALOHA.

4.7 Acoustic Doppler Current Profiler

The ship's acoustic Doppler current profiler (ADCP) will be in operation during the duration of the cruise. The OTG electronics technicians will be in charge of the ADCP system.

4.8 Thermosalinograph, $pCO_2$ system, Fluorometer, and meteorological system

The ship's thermosalinograph, $pCO_2$ 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. Salinity samples to calibrate the thermosalinograph will be taken from the intake hose at 4-hour intervals throughout the duration of the cruise by the science personnel. 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, $pCO_2$ system, Fluorometer, and meteorological suite operations.

5.0 EQUIPMENT

5.1 The HOT science party shall be bringing the following

1. Seabird CTD system, all sensors, deck boxes and computer CTD acquisition systems
2. Rosette and 24 12L Bullister sampling bottles, and all associated spare parts
3. One 20 ft. laboratory van with assorted equipment for radioisotope and general use (Van #23)
4. One 12 ft. equipment van ("Blue" Van)
5. Distilled, deionized water and all required chemicals and isotopes
6. Large vacuum waste container
7. Liquid nitrogen dewar
8. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights

9. Kevlar line, polypropylene line
10. Sediment traps and crosses
11. Drifting primary production array and gas array with light and radio transmitter, floats, weights, spectra and polypro line, spare buoy, etc.
12. Hyperpro and other optical measuring instruments.
13. Oxygen titration system
14. Plankton nets and towing lines
15. Desktop and laptop personal computers
16. Assorted tools
17. All required sampling bottles
18. Deck incubation system
19. Pertinent MSDS

5.2 We will need the use of the following ship's equipment:

1. A-frame
2. A-frame block assembly
3. Trawl winch with conducting wire for CTD
4. Electric power for winches (440 VAC, 3 phase, 60 Amp breaker) and vans (208 VAC single phase at 60 amps for lab van, 110 VAC 10 amps for equipment van)
5. Radio direction finder
6. Space on the main deck for one equipment van
7. Space on upper deck for two laboratory vans
8. Space on upper deck for incubators
9. Hand-held VHF transceivers
10. Precision depth recorder
11. Shackles, sheaves, hooks and lines
12. Shipboard Acoustic Doppler Current Profiler
13. Thermosalinograph, *p*CO2 system, and Fluorometer
14. Meteorological suite
15. Copy machine
16. Grappling hooks and line
17. Laptop with Nobeltec charting software and GPS feed
18. Running fresh water and seawater hoses
19. Electronic mail system
20. GPS system
21. Uncontaminated seawater supply
22. Small capstan (~ 10 m/min)
23. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, *p*CO2 and access to real-time data through the network.
24. OTG's 24-place rosette, and 24 12L water sampling bottles (to be used as spare)
25. 1300 lb weight.
26. Large Sea-Mac winch (Mod. 1025 EHS). 60 Amp Hubbel plug/connector (440 VAC, 3 phase, 60 Amp breaker)

**Ship: R/V *KILO MOANA*** **HOT 260 CTD CASTS** **Date: Feb 13-Feb 17, 2014**

| Cast | | Samples | #Bottles |
|---|---|---|---|
| **Kahe Pt.** | | | |
| s1c1 | 1000 m | $O_2$, Temp, DIC/Alk, Nuts, Chl a, LLN, LLP, DOC, FCM, Salts JF(pb all depths) | 24 |
| **Station ALOHA** | | | |
| s2c1 | 1000 m | Primary Production, Salts | 22 |
| s2c2 | 4740 m (PO-1) | $O_2$, Temp, DOC, DIC/Alk, Nuts, Salts | 24 |
| s2c3 | 1000 m (PO-2) | $O_2$, Temp, DOC, DIC/Alk, Nuts, Salts, JF(pb@8 O2 depths) | 24 |
| s2c4 | 1000 m | PC/PN, SG(pb@5,25,45,75,100,125,150,175,sal min,1000), Salts | 14 |
| s2c5 | 1000 m | PPO4, Salts | 14 |
| s2c6 | 1000 m (BEACH) | $O_2$, Temp, DIC/Alk, Nuts, LLN, LLP, DOC, Keeling, Quay, SF-S(1@25), Salts | 24 |
| s2c7 | 1000 m | PUR, SF-S(1@25), Salts | 11 |
| s2c8 | 1000 m | Gas Array(2@5,25,45,75,100,125), SF-S(1@25), Salts | 15 |
| s2c9 | 1000 m | PO(6@1000), SF-S(1@25), Salts | 9 |
| s2c10 | 1000 m | PSi, MC(1@5,25,45,75,100,125,150,175), SF-S(1@25), Salts | 19 |
| s2c11 | 1000 m | CS(2@5,25,45,75,100,125,150,175), SF-S(1@25), Salts, JF(pb 1@5,25,45,75,100,125,150,175) | 19 |
| s2c12 | 1000 m | ATP, MC(1@200,300,500,770), SW(1@700), SF-S(1@25), Salts | 17 |
| s2c13 | 1000 m | MC(1@5,25,45,75,100,125,150,175), SW( pb MC), SF-S(1@25), Salts | 11 |
| s2c14 | 1000 m | HPLC, Chl a, Slides, Salts | 22 |
| s2c15 | 4740 m (PO-3) | Oxygen, MC(1@1000,2000,3000,4000), BL(1@10,250,500,2000,2500,3000,3500,4000,4500), Salts | 21 |
| **WHOTS Mooring** | | | |
| s52c1 | 200 m yo-yo | DS(1@5), KT-K(1@5,25,45,75,125,150) | 7 |
| **Kaena** | | | |
| s6c1 | 2400 m | Chl, Salts | 13 |

**MC**=Matt Church, **SW**=Sam Wilson, **KD**=Ken Doggett, **CS**=Chris Schvarcz, **DS**=Dan Sadler, **JF=**Jim Foley, **SG**=Stu Goldberg, **SF-S**=Sara Ferrón-Smith, **KT-K**=Kendra Turk-Kubo, **BL**=Boaz Luz

**Ship: R/V *KILO MOANA*  HOT 260  Date: Feb 13-Feb 17, 2014**

| TIME | Thurs. 2/13 | Fri. 2/14 | Sat. 2/15 | Sun. 2/16 | Mon. 2/17 |
|---|---|---|---|---|---|
| 0000 | | | | | |
| 0100 | | | | | |
| 0200 | | S2C1 PP | S2C8 Gas | | |
| 0300 | | | | AC9/FRRF | |
| 0400 | | Deploy PP Array | Deploy Gas Array | | |
| 0500 | | S2C2 PO-1 | S2C9 Open | Transit gas array | |
| 0600 | | | | Recover gas array<br>Transit sed traps | |
| 0700 | | | | Recover sed traps | |
| 0800 | | | S2C10 PSi | Transit ALOHA | Arrive Snug |
| 0900 | Depart Snug | | | | |
| 1000 | | Net Tow | Net Tow<br>ATE | AC9/FRRF | |
| 1100 | Arrive Kahe (11:30)<br>Weight cast | S2C3 PO-2<br>(Begin 36 hr) | S2C11 Open | | |
| 1200 | S1C1 Kahe | | Net Tow | Transit St. 52<br>S52C1 WHOTS | |
| 1300 | | Hyperpro | | | |
| 1400 | Hyperpro | S2C4 PC/PN | S2C12 ATP | Hyperpro | |
| 1500 | 20m Niskin cast<br>Transit ALOHA | | Hand net tow | Transit St. Kaena | |
| 1600 | | | | | |
| 1700 | | S2C5 PPO4 | S2C13 Open | | |
| 1800 | | Recover PP array | | | |
| 1900 | | | | | |
| 2000 | | S2C6 BEACH | S2C14 HPLC | | |
| 2100 | | | | S6C1 Kaena | |
| 2200 | | Net Tow<br>Net Tow | Net Tow | | |
| 2300 | Arrive ALOHA<br>Deploy sed traps | S2C7 PUR | S2C15 PO-3<br>(end 36 hours) | Transit Snug | |

**February 14th: Sunrise 0710, Sunset 1822**

## 6.0 HOT-260 Watch Schedule

**0300-1500**

Adriana Harlan – *Water Boss*
Dan Sadler – *Tag*
Lance Fujieki – *Alt. Tag*
Jefrey Snyder – Watch Leader – *Tag*
Daniel McCoy – *Console*
Damion Rosbrugh – *Alt. Tag*

**1500-0300**

Brett Updyke – Chief Scientist – *Tag*
Susan Curless – Watch Leader – *Water Boss*
Cameron Fumar – *Console*
Joseph Gum – *Tag*
Kapono Gaughen – *Alt. Tag*

**1000-2200**

Stuart Goldberg

**At Large**

Blake Watkins
Brenner Wai
William McQuiston
David Ho
Benjamin Hickman
Eugene Gorman
James Foley
Kimberlee Stewart
Elizabeth Eubanks
Robyn Ehrlich

**OTG**

Jeff Koch
Justin Smith
Steve Tottori