Hawaii Ocean Time-series
HOT-344 Cruise Plan

Cruise ID: KM 23-14
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Christopher Amorant
Chief Scientist: Fernando Carvalho Pacheco, University of Hawaii at Manoa
Marine Technicians: Trevor Young (lead), Ben Duncan

Marine Center phone number: (808) 956-0688
KM phone numbers (in port): 808-587-8566 / 67
KM cell phone: 808-864-0065
KM sat phone (voice): 011-870-773-234249
KM sat phone (fax): 011-870-783-207825
Fernando Carvalho Pacheco Cell Number, email: (808)4458275, fernando.pacheco@hawaii.edu

Pre-Cruise Meeting: September 7, 2023 at 1330 via Zoom.
Start pre-embarkation protocols (masking, social distancing): September 7, 2023.
COVID Testing: September 14, 0830-0900, Pier 35.
Loading: September 14 (Thursday) at 0900, Pier 35.
Departure: September 15 at 0800 (Friday, **Science personnel at UHMC by 0700**).
Arrival: September 19 at 0800.
Post-Cruise Meeting: September 20 at 1330 via Zoom.

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:

1) Station 1, referred to as Station Kahe, is located at 21° 20.6'N, 158° 16.4'W and will be occupied on September 15 for about 3-4 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 September 16 – September 18.
3) Station 50, the site of WHOTS-19 Mooring (anchor position 22° 46.002'N, 157° 53.958'W) will be occupied for about 3-4 hours on September 18th.
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 September 18 for about 2 hours.

1.1 SCIENTIFIC OPERATIONS

Station	Activities
Kahe (Sta. 1)	Weight Cast, Hyperpro cast, CTD cast (1000 m), Trace Metal CTD
ALOHA (Sta. 2)	Sediment traps, Primary productivity array, Gas array, Net tows, CTD operations, Trace Metal CTD casts
WHOTS mooring station (Sta. 50)	One CTD cast (yo-yo to 200 m), Hyperpro, surface instrument intercomparisons.
Kaena (Sta. 6)	One near-bottom CTD cast (~ 2400 m)
Underway/continuous	ADCP, thermosalinograph, fluorometry, meteorology, C-Star

2.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
Grieg Steward	Scientist	UH	USA
Julie Thomy	Post-Doc	UH	FRA
Kelsey McBeain	Technician	UH	USA
Catherine Crowley	Graduate Student	U of Connecticut	USA
Raquel Flynn	Graduate Student	Chapel Hill	ZAF
Meredit Meyer	Graduate Student	Chapel Hill	USA
Huei-Ting Lin (Tina)	Associate Professor	NTU	TWN
Yu-Chen Yen (Karen)	Research specialist	NTU	TWN
Josephine Dianne Deauna	Graduate Student	UH	PHL
Chloe Obara	Graduate Assistant	UH	USA
Reece James	Graduate Student	UH	USA
Natalie Summers	Graduate Student	UH	USA
Eleanor Bates	Graduate Student	UH	USA
Angelicque White	Scientist	UH	USA
Carolina Funkey	Research Associate	UH	USA
Karin Björkman	Research Specialist	UH	SWE
Brandon Brenes	Graduate Student	UH	USA
Fernando Carvalho Pacheco	Research Associate	UH	BRA
Dan Fitzgerald	Research Associate	UH	USA
Merritt Shepherd	Graduate Student	UH	USA
Tully Rohrer	Research Associate	UH	USA
Blake Watkins	Marine Engineer	UH	USA
Ben Duncan	OTG	UH	USA
Trevor Young	OTG	UH	USA

3.0. SUMMARY SCHEDULE

7 Sept	Pre-cruise planning meeting 1330 hrs, via Zoom.
14 Sep	COVID TESTING 0830-0900, Pier 35.
14 Sep	Equipment loading at 0900 hrs, Pier 35.
15 Sep	Depart from Pier 35 at 0800 hrs. **Science personnel to UHMC by 0700.**
15 Sep	Station 1 Kahe Pt. operations.
16-18 Sep	Station 2 ALOHA operations, Station 50 CTD yo-yo cast, Station 6 deep cast.
19 Sep	Arrive back to Pier 35.
20 Sep	Post-cruise meeting at 1330 hrs via Zoom

4.0. OPERATIONAL PLANS

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

A 1300 lb. weight-test cast to 500 m will be conducted, **including testing of the emergency systems on the docking head of the Hawboldt LARS system.** These tests will include the Manual Anti-2 Block Test, the Auto with LARS Anti 2-block test, and the Auto with LARS switch malfunction test as described in previous cruise plans. A Hyperpro cast (Sect. 4.2.7), one CTD cast to 1000 m (4.2.4), and a Trace Metal CTD cast (4.5) will be conducted at this location. The ship's A-frame, CTD winch, and TM winch will be needed for these operations. After the operations are satisfactorily completed, the ship shall proceed to Station ALOHA.

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

4.2.1. Upon arrival to Station ALOHA, the Sediment Trap Array (Sect 4.2.2) (*) will be deployed. After this operation is completed, one 200m cast for Julie's group and then a 1000-m (or 200m depending on time) cast will be conducted to collect water for the Primary Production Array. Following this, the Primary Production array will be deployed (4.2.3). These operations will be followed by a near-bottom CTD cast and the start of the 36-hour water column observations at Station ALOHA.

(*) NOTE: The deployment of all drifting array must be determined by observed local and forecasted currents to avoid possible entanglement with the WHOTS mooring.
Array tracking is facilitated through the SOEST Cruise and Drifter Tracks tool found at
http://hahana.soest.hawaii.edu/nowcast/loctable.html

4.2.2. Sediment trap array deployment

The floating sediment traps will be from the back of the deck through the A-frame and using the SeaMac winch. After deployment we request that the bridge verify that the radio transmitters are functioning and directionally correct. The Sediment Trap array will consist of one cross with 12 particle interceptor traps (PIT) at 150 m, and one cross above it with 4 traps.

The array will drift for about 70 hours before recovery. The array is equipped with 1 XEOS Iridium transmitter, 1 RockBlock Iridium beacon, strobe lights, and a radio transmitter (see section 6.0 for transmitter IDs). 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. **Blake Watkins** will direct this deployment.

4.2.3. Primary production experiment

Samples for the primary productivity experiment will be collected from the rosette. Before dawn (Sunrise 0619 hrs on September 16 ,**https://gml.noaa.gov/grad/solcalc/)**, a free drifting incubation array will be deployed from the back of the deck thru the A-frame and using the SeaMac winch. The primary production incubation array will be deployed at a location within Station ALOHA to be determined by observed local and forecasted currents to avoid possible entanglement with the WHOTS mooring. (See section 6.0 for Trasmitter IDs).

The array will be recovered around sunset (1834 hrs on September 16). 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. **Blake Watkins** will direct this deployment.

After deployment of the Primary Production Array, the ship shall transit to the center of the station circle to conduct a bottom CTD cast, S2C2 (approximately 4740 m).

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 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. 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 three hours for a 36-hour period, ending with a second near-bottom cast. 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, 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 (**Dan Fitzgerald and Tully Rohrer)**.

4.2.5. Lowered Acoustic Doppler Current Profiler (LADCP)

The LADCP will not be deployed on this cruise.

4.2.6. Gas Array deployment

A free drifting incubation array will be deployed the third day of the cruise at Station ALOHA. Samples for the gas array will be collected from station 2 CTD cast 9. The gas array will be deployed from the back of the deck thru the A-frame and using the SeaMac winch. The gas array will be deployed at a location within Station ALOHA to be determined by observed local and forecasted currents to avoid possible entanglement with the WHOTS mooring. The array is equipped with GPS transmitters, strobe lights and a radio transmitter (See Section 6.0 for transmitter IDs). 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. **Blake Watkins** will oversee this deployment.

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. Around 1400 on the first, third and fifth days, the Hyperpro will be deployed from the stern through a small block hung from the A-frame. The instrument is lowered and retrieved by hand. Each deployment will consist of two profiles and one yo-yo (5 x 20m) before the instrument is retrieved.

4.2.8. Underwater Vision Profiler (UVP)

The UVP will be installed on the rosette inside the frame using clamps provided by HOT. This instrument will require a modified CTD deployment procedure in which the CTD/rosette is lowered into the water and allowed to soak for one minute before being deployed to 15m as rapidly as is safe for the winch. The instrument will only turn on if the average descent rate is >18 m/min. HOT personnel will be responsible for maintaining this instrument before and after CTD casts.

4.2.9. Zooplankton 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 third, fourth and fifth days (see schedule) for a total of six slots. The A-frame and small capstan will be needed for this operation. **Blake Watkins** will direct these operations.

4.3 Gas Array and Sediment Trap Array recovery

In the morning of September 18, 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 array. After the Gas Array is recovered, the ship shall transit to recover the floating sediment trap array. **Blake Watkins** will oversee these operations. After the sediment trap array is recovered, the ship shall transit to Station 50.

4.4. Station 50 - WHOTS-19 Mooring

The anchor position of the WHOTS-19 mooring is 22° 46.002'N, 157° 53.958'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. Upon arrival at Station 50 on September 18, one 200 m CTD yo-yo cast and ADCP intercomparisons will be conducted.

4.5. Trace Metal Clean Rosette

Vertical profiles between 0-600m will be conducted for trace metal analysis using a rosette package with autonomous Auto Fire Module. This mini-CTD rosette consists of a SeaBird CTD attached to a 12-place rosette with 8-liter Niskin sampling bottles. The rosette is approximately 5 ft x 5ft x 4 ft and weighs 355/565 lbs in air empty/full. We will deploy the CTD rosette using the W2 winch, delrin block and 1/4" Amsteel line using trace metal clean procedures from the stern of the vessel using the A-Frame. Eleanor Bates will oversee this operation. **We request the ship's personnel to contact us before doing any trash burning or any cooking that would disseminate smoke to the labs or working area**.

4.6. Station Kaena (21° 50.8'N, 158° 21.8'W) *TBD*

A near-bottom CTD cast (~2500 m) will be conducted at this location in the evening of September 18. Once the CTD cast is complete, the ship shall return to Pier 35.

4.7. Acoustic Doppler Current Profiler

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

4.8. Thermosalinograph, Fluorometer and pCO_2

The ship's thermosalinograph, fluorometer and pCO_2 sampling the uncontaminated seawater supply system will be in operation during the duration of the cruise while the ship is outside of Honolulu Harbor. Salinity samples to calibrate the thermosalinograph will be taken from the intake hose at about 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 oversee the thermosalinograph, fluorometer, and meteorological suite operations.

4.9. Inline C-Star Transmissometer and IFCB

In addition to the continuous thermosalinograph and fluorometer sampling, the inline C-Star Transmissometer will sample continuously from the uncontaminated seawater supply system throughout the duration of the cruise while the ship is outside of Honolulu Harbor. The Imaging Flow CytoBot (IFCB) will also be used on this cruise. Access to real-time underway data through the ship's network is required. UH personnel will oversee these instruments and operations.

4.10. Video Plankton Recorder (VPR) Cast

A digital autonomous Video Plankton Recorder (VPR) will be deployed multiple times during the cruise. Tow speed 1.5 knots, payout/recovery speed 30 meters per minute using the SeaMac winch. The system should be continuously oscillated between the surface and the maximum line out depth. The orange synthetic Dyneema line shall be used for this deployment. Deployments should be at least 45 minutes in the water. A two-hour block will allow for 3 profiles.

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. One 20 ft. laboratory van (#23 - HOT Rad Van) with assorted equipment for radioisotope and general use, one 10 ft van **(#540A PO Equipment van),** and one trace metal 20 ft van (#581).
3. Distilled, deionized water and all required chemicals and isotopes
4. Large vacuum waste containers
5. Liquid nitrogen dewars

6. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights, line, sediment traps and crosses.
7. Drifting primary production array with strobe lights, satellite and radio transmitters, floats, weights, line primary production bottles and spreader bars.
8. Drifting gas array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and short mounting bars.
9. Oxygen titration system
10. Plankton nets and towing lines
11. Desktop and laptop personal computers
12. Assorted tools
13. All required sampling bottles
14. Pertinent MSDS
15. SeaFlow
16. Inline C-Star Transmissometer
17. Trace metal clean rosette with 8L Niskin bottles and programmable CTD
18. Underwater Vision Profiler (UVP)
19. Video Plankton Recorder (VPR)
20. 3 incubators (baby blue 1, big blue 1 and 2), stored on 02 Deck
21. Hose Reel (43" x 43")
22. 24-place rosette, and 24 12-l water sampling bottles (**to be used as primary system**)

2. We will need the use of the following ship's equipment:
   1. A-frame
   2. A-frame block assembly
   3. CTD winch
   4. Electric power
      -440/480 VAC, 3 phase 60Hz, 60amp for winches
      -208 VAC single phase at 60 amps for lab vans
   5. Space on upper 01 deck port side for one 10 ft van(#540A PO Equipment van)
   6. Space on upper 01 deck port side for 20 ft. laboratory van (#23 - HOT Rad Van)
   7. Space on upper 01 deck starboard side for trace metal 20 ft van (#581)
   8. Space on 02 deck for three incubators
   9. Space on deck for ~4 deck baskets of array gear
   10. Small capstan (~ 10 m/min)
   11. SeaMac Winch
   12. W2 winch
   13. Radio direction finder
   14. Hand-held VHF transceivers
   15. Shackles, sheaves, hooks and lines
   16. Precision depth recorder
   17. Shipboard Acoustic Doppler Current Profiler
   18. Thermosalinograph, pCO_2 system, and Fluorometer
   19. Meteorological suite
   20. Grappling hooks and line
   21. Navlink2 PC or equivalent
   22. Running fresh water and seawater, hoses
   23. Uncontaminated seawater supply
   24. Source of compressed air for Trace Metal pump
   25. -80°C Freezer
   26. 4°C Refrigerator and -20°C Freezer
   27. Distilled, deionized water system

28. Email system
29. GPS system
30. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, SeaFlow, and inline C-Star transmissometer and access to real-time data through the network.
31. OTG's 24-place rosette, and 24 12-l water sampling bottles (**to be used as backup**)
32. ~1300 lb weight
33. Remote CTD dbar pressure display in the winch operator area.
34. Monitor in CTD Lab displaying ship coordinates, bottom depth and GMT.
35. OTG's transmissometer
36. OTG's altimeter
37. Trace metal free block
38. Amsteel Line (1/4") for trace metal clean work

6.0 Satellite Position Transmitters Summary

Array Name	RockBlock ID	XEOS ID	Argos ID	Radio Frequency
Sediment Trap (ST)	06	268		CH.68 (156.425 MHz)
Primary Production (PP)	08	266		CH.69 (156.475MHz)
Gas Array (GA)	08	266		CH.69 (156.475MHz)

NOTE: Array tracking is facilitated through the SOEST Cruise and Drifter Tracks tool found at http://hahana.soest.hawaii.edu/nowcast/loctable.html

Ship: R/V *Kilo Moana* **HOT 344 CTD CASTS** **Date: September 15-19, 2023**

Cast		Samples	#Bottles
Kahe Pt.			
s1c1	1000 m	O_2, Temp, DIC/Alk, pH, Nuts, LLN, LLP, Chl a, Salts, **RF** (shakedown? 3@500)	18
Station ALOHA			
s2c1	200 m	**JG-1**(24@DCM)	24
s2c2	1000 m	Primary Production (3@ 5, 25, 45, 75, 100, 125, 150, 175) Chl a, FCM, DIC, Salts	24
s2c3	4740 m (PO-1)	O_2, Temp, DOC, DIC/Alk, pH, Ref Si, Nuts, Salts **TH(**1@5,20,60,100,250,300,400,500,550,600,650,700,750,800, 1000,1200,1600,2000,2600,3000,3600,4000,4500,4800**)**	24
s2c4	1000 m (PO-2)	O_2, Temp, DOC, DIC/Alk, pH, Nuts, Ref Si, Salts	24
s2c5	1000 m	PC/PN, **DL** (pb@5,25,45,75,100,125,150,175), Salts,	22
s2c6	1000 m	PPO4 , Salts, **GS**(6@25)	20
s2c7	1000 m (BEACH)	O_2, Temp, DIC/Alk, pH, Nuts, LLN, LLP, DOC, Keeling, Quay, Salts, **JG**(1@5)	24
s2c8	1000 m	Open, **JG-2** (9@5; 3@btw SFC&DCM, 8@DCM) , Salts	22
s2c9	1000 m	Gas Array (3@5,25,45,75,100,125), **MC** (1@5, 25, 45, 75, 100, 125, 150, 175) ,Salts	22
s2c10	1000 m	Open, **JG-3(**20@5) , Salts	22
s2c11	1000 m	PSi, Salts,	10
s2c12	1000 m	Open, **JG-4** (8@5; 3@btw 5 &DCM; 8@DCM; 1@MLD) , Salts	22
s2c13	1000 m	ATP, **SD** (6@20-25(Mixed Layer), Salts	17
s2c14	1000 m	Open, **JG-5** (8@5, 3@btw 5&DCM, 8@DCM), Salts	21
s2c15	1000 m	HPLC, Chl a,**GS**(6@DCM), Salts	20
s2c16	4740 m (PO-3)	Oxygen, **TH(**1@5,20,60,300,400,500,550,600,650,700,750,800, 1000,1250,1500,2000,2500,3000,3500,4000,4500,4800**)**, Salts	24
s2c17	200 m	Open, **JG-6** (8@5, 3@btw 5 &DCM; 8@DCM) , Salts	23
WHOTS Mooring			
s50c1	200 m yo-yo	**GS**(6@75)	9
Kaena			
s6c1	2400 m	Chl a, Salts	13

MC=Matt Church**, SD** = Sonya Dyhrman, **DL** = Debbie Lindell, **JG**=Julie Granger, **RF=**Raquel Francesca, **GS** = Grieg Steward, **TH** = Tina Huei-Ting

Ship: R/V *Kilo Moana* HOT 344 Date: September 15–19, 2023

TIME	Friday 15/9	Saturday 16/9	Sunday 17/9	Monday 18/9	Tuesday 19/9
0000		Deploy Sed Traps	VPR Cast 1		
0100		S2C1 JG-1 (DCM/200m)			
0200		S2C2 PP	S2C9 Gas Array		
0300					
0400		Deploy PP Array	Deploy Gas Array	Transit Gas Array	
0500		S2C3 PO-1 (Deep)	S2C10 Open (JG-3/SFC)		
0600			Transit to pump tanks Incinerator	Recover Gas Array	
0700	All Sci. Aboard			Transit Sed Traps	
0800	Depart Pier 35		S2C11 PSi	Recover Sed Traps	Arrive to Pier 35
0900			Trace Metal - EB 3	Transit to WHOTS (S50)	
1000		Trace Metal - EB 2		S2C17 Open (JG-6)	
1100	Arrive Kahe	S2C4 PO-2 (Begin 36 hr)	S2C12 Open (JG-4)	Transit to WHOTS (S50)	
1200	Weight Cast Hyperpro	Net Tow	Net Tow Net Tow		
1300	S1C1 Kahe	Hyperpro		S50C1 WHOTS	
1400	Trace Metal- EB 1 (Rinse)	S2C5 PC/PN	S2C13 ATP	VPR Cast 3	
1500	Transit to ALOHA	Transit to Pump Tanks	VPR cast 2	Transit to Kaena (S6C1)	
1600					
1700		S2C6 PPO4	S2C14 Open (JG-5)		
1800		Transit to PP array Recover PP array	Trace Metal - EB 4		
1900			Pump Tanks		
2000		S2C7 BEACH	S2C15 HPLC	S6C1 Kaena	
2100	Pump Tanks				
2200	Arrive ALOHA	Net Tow Net Tow	Net Tow	Transit to Pier 35	
2300		S2C8 Open (JG-2)	S2C16 PO-3 (Deep) (end 36 hours)		

September 16, 2023 : Sunrise 0619, Sunset 1834
(22.75, -158; https://gml.noaa.gov/grad/solcalc/)

6.0 HOT-344 Watch Schedule

0300-1500

Dan Fitzgerald - Watch Leader
Carolina Funkey - Water Boss
Angelicque White
Fernando Carvalho Pacheco - Console, Chief Scientist
Chloe Obara - Volunteer

1500-0300

Karin Björkman – Water Boss
Brandon Brenes
Tully Rohrer – Console, Watch Leader
Merritt Shepherd
Josephine Dianne Deauna - Volunteer

0900-2100

Natalie Summers

At Large

Eleanor Bates
Blake Watkins
Reece James
Grieg Steward
Julie Thomy
Kelsey McBeain
Catherine Crowley
Raquel Flynn
Meredit Meyer
Huei-Ting Lin (Tina)
Yu-Chen Yen (Karen)

OTG

Benjamin Duncan
Trevor Young (lead)