Hawaii Ocean Time-series
HOT-348 Cruise Plan

Cruise ID: KM 23-22
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Captain Christopher Amorant
Chief Scientist: Fernando Carvalho Pacheco, University of Hawaii at Manoa
Marine Technicians: Lance Frymire, Ben Duncan

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Pre-Cruise Meeting: December 19, 2023, at 1300 via Zoom.
Start pre-embarkation protocols (masking, social distancing): December 19, 2023.
COVID Testing: December 26, 0700-0900 at UHMC.
Loading: December 26 (Tuesday) at 0900, Pier 35.
Departure: December 26 at 1300 (**Science personnel at UHMC by 0900**).
Arrival: December 31 (Sunday) at 0800.
Post-Cruise Meeting: January 2, 2024 (Tuesday) 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 December 26th 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 December 27-30.
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 December 30.
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 December 30 for about 2 hours.

1.1 SCIENTIFIC OPERATIONS

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

2.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
Edoardo Sena	Undergraduate	UH	USA
Klara Sobotikova	Graduate Student	HPU	CZE
Caroline Holmes	Artist	UH	USA
Logan North	Undergraduate	UH	USA
Alexandrya Robinson	Undergraduate	UH	USA
Joel Nicolow	Undergraduate	UH	USA
Andrew Hirzell	Post-Doc	UH	USA
Karin Björkman	Scientist	UH	SWE
Brandon Brenes	Graduate Student	UH	USA
Dan Fitzgerald	Research Associate	UH	USA
Carolina Funkey	Research Associate	UH	USA
Fernando Carvalho Pacheco	Chief Scientist	UH	BRA
Dan Sadler	Research Associate	UH	USA
Merritt Shepherd	Research Assistant	UH	USA
Tully Rohrer	Research Associate	UH	USA
Blake Watkins	Marine Engineer	UH	USA
Ben Duncan	OTG	UH	USA
Lance Frymire	OTG	UH	USA

3.0. SUMMARY SCHEDULE

19 Dec	Pre-cruise planning meeting 1300 hrs, via Zoom.
26 Dec	Equipment loading at 0900 hrs, Pier 35.
26 Dec	Self-COVID Testing, 0700-0900 at UHMC.
26 Dec	Depart from Pier 35 at 1300 hrs. **Science personnel to UHMC by 0900.**
27 Dec	Station 1 Kahe Pt. operations.
27-30 Dec	Station 2 ALOHA operations, Station 50 CTD yo-yo cast, Station 6 deep cast.
31 Dec	Arrive back to Pier 35.
2 Jan 2024	Post-cruise meeting at 1300 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 CTD cast to 1000 m (4.2.4) will be conducted at this location. The ship's A-frame and CTD 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 at Station ALOHA, a cast at 0200 will be conducted to collect water for the Primary Production Array. Following this, the Primary Production array (4.2.3) and the Sediment Trap Array (Sect 4.2.2*) will be deployed. These operations will be followed by a Trace Metal Cast (4.10) , VPR (4.9), Net Tow

(4.2.9), and HyperPro (4.2.7). The near-bottom CTD cast and the start of the 36-hour water column observations at Station ALOHA will start on December 28.

(*) 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.

The array will drift for about 70 hours before recovery. The array has 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 0711 on December 27, **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 Transmitter IDs).

The array will be recovered around sunset (1756 on December 27). 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.

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 deep cast S2C2 (PO-1) shall be made on December 28 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 (**Fernando Carvalho Pacheco**) or the watch leaders (**Carolina Funkey 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 8. 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 1200 on the second, and fifth day, 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 second, third and fourth 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 December 30, 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 recovering the Gas Array, 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 December 30, one 200 m CTD yo-yo cast and ADCP intercomparisons will be conducted.

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 December 30. Once the CTD cast is complete, the ship shall return to Pier 35.

4.6. 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.

4.7. 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 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.

4.8. 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 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.

4.9. 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 (>1 knot through the water), payout/recovery speed 20 meters per minute using the SeaMac winch. The system should be continuously oscillated between the surface and the maximum line out depth (400m). 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 ~2 profiles.

4.10. Trace Metal Clean Rosette

A vertical profile between 0-400m 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. **Fernando C. Pacheco** 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

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). *** *No 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. Underwater Vision Profiler (UVP)

18. Video Plankton Recorder (VPR)
19. 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. **NO trace metal 20 ft van (#581)*
   8. Space on deck for ~4 deck baskets of array gear
   9. Small capstan (~ 10 m/min)
   10. SeaMac Winch
   11. W2 winch
   12. Radio direction finder
   13. Hand-held VHF transceivers
   14. Shackles, sheaves, hooks and lines
   15. Precision depth recorder
   16. Shipboard Acoustic Doppler Current Profiler
   17. Thermosalinograph, pCO_2 system, and Fluorometer
   18. Meteorological suite
   19. Grappling hooks and line
   20. Navlink2 PC or equivalent
   21. Running fresh water and seawater, hoses
   22. Uncontaminated seawater supply
   23. -80°C Freezer
   24. 4°C Refrigerator and -20°C Freezer
   25. Distilled, deionized water system
   26. Email system
   27. GPS system
   28. 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.
   29. OTG's 24-place rosette, and 24 12-l water sampling bottles (**to be used as backup**)
   30. ~1300 lb weight
   31. Remote CTD dbar pressure display in the winch operator area.
   32. Monitor in CTD Lab displaying ship coordinates, bottom depth and GMT.
   33. OTG's transmissometer
   34. OTG's altimeter

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 (156.475 MHz)
Gas Array (GA)	08	266		CH.69 (156.475 MHz)

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 348 CTD CASTS** **Date: December 26-Dec 31, 2023**

Cast		Samples	#Bottles
Kahe Pt.			
s1c1	1000 m	O_2, Temp, DIC/Alk, pH, Nuts, LLN, LLP, Chl a, Salts	17
Station ALOHA			
s2c1	1000 m	Primary Production (3@ 5, 25, 45, 75, 100, 125, 150, 175) Chl a, FCM, Salts	24
s2c2	4740 m (PO-1)	O_2, Temp, DOC, DIC/Alk, pH, Ref Si, Nuts, Salts	24
s2c3	1000 m (PO-2)	O_2, Temp, DOC, DIC/Alk, pH, Nuts, Ref Si, Salts	24
s2c4	1000 m	PC/PN, Salts	14
s2c5	1000 m	PPO4, Salts	16
s2c6	1000 m (BEACH)	O_2, Temp, DIC/Alk, pH, Nuts, LLN, LLP, DOC, Keeling, Quay, Salts	23
s2c7	1000 m	Open, Salts	3
s2c8	1000 m	Gas Array (3@5,25,45,75,100,125), **MC** (1@5, 25, 45, 75, 100, 125, 150, 175), Salts	24
s2c9	1000 m	Open, Salts	3
s2c10	1000 m	PSi, Salts	12
s2c11	1000 m	Open, Salts, **DL** (1@5,25,45,75,100,125,150,175)	10
s2c12	1000 m	ATP, Salts	11
s2c13	1000 m	Open, Salts,	24
s2c14	1000 m	HPLC, Chl a, Salts	14
s2c15	4740 m (PO-3)	Oxygen, Salts	24
WHOTS Mooring			
s50c1	200 m yo-yo	-	0
Kaena			
s6c1	2400 m	Chl a, Salts	13

MC = Matt Church**, DL** = Debbie Lindell

TIME	Tuesday 12/26	Wednesday 12/27	Thursday 12/28	Friday 12/29	Saturday 12/30
0000		Pump tanks. Incinerator		VPR-6 Cast (2h)	
0100		Arrive to ALOHA Maybe Deploy Sed T.?			
0200		S2C1 PP *(200m if not enough time)*	Transit to pump tanks Incinerator	S2C8 Gas Array	
0300					Transit to pump tanks. Incinerator
0400		Deploy PP Array	S2C2 PO-1(Deep)	Deploy Gas Array	Transit Gas Array
0500		Deploy Sed Trap		S2C9 Open	Recover Gas Array
0600		Trace Metal Cast (400m)		Transit to pump tanks. Incinerator	Transit Sed Traps
0700	Loading(PO)				Recover Sed Traps
0800	COVID Self-Testing UHMC	VPR-1 Cast (3h)	VPR-5 Cast(2h)	S2C10 PSi	Transit to WHOTS (S50)
0900	Loading (Everyone)				S50C1 WHOTS
1000					VPR-8 Cast (3h)
1100		Net Tow	S2C3 PO-2 (Begin 36 hr)	S2C11 Open	
1200	Maybe Depart earlier???	HyperPro	Net Tow	Net Tow Net Tow	
1300	Depart Pier 35	VPR-2 Cast (3h)	HyperPro?		HyperPro
1400			S2C4 PC/PN	S2C12 ATP	Transit To St. Kaena (S6C1)
1500			Transit to pump tanks Incinerator	VPR-7 Cast (2h)	Pump Tanks Incinerator
1600	Arrive Kahe Weight Cast	Transit to pump tanks Incinerator			
1700	S1C1 Kahe		S2C5 PPO4	S2C13 Open	
1800	Transit to Aloha	Transit to PP array		Transit to pump tanks Incinerator	
1900		Recover PP array			
2000		VPR-3 Cast (2h)	S2C6 BEACH	S2C14 HPLC	S6C1 St Kaena
2100					
2200		Net Tow Net Tow	Net Tow		
2300		VPR-4 Cast (3h)	S2C7 Open	S2C15 PO-3 (Deep) (end 36 hours)	Transit to Pier 35

December 27, 2023: Sunrise 0711, Sunset 1756
(22.75, -158; https://gml.noaa.gov/grad/solcalc/)

TIME	Sunday 12/31

0000	
0100	
0200	
0300	
0400	
0500	
0600	
0700	
0800	Arrive Pier 35
0900	
1000	
1100	
1200	
1300	
1400	
1500	
1600	
1700	
1800	
1900	
2000	
2100	
2200	
2300	

6.0 HOT-348 Watch Schedule

0300-1500

Dan Fitzgerald - Watch Leader
Carolina Funkey - Water Boss
Fernando Carvalho Pacheco – Console, Chief Scientist
Dan Sadler
Joel Nicolow
Logan North
Klara Sobotikova

1500-0300

Karin Björkman – Water Boss
Brandon Brenes
Tully Rohrer – Console, Watch Leader
Merrit Shepherd
Edoardo Sena
Caroline Holmes

At Large

Blake Watkins
Andrew Hirzell
Alexandrya Robinson

OTG

Benjamin Duncan
Lance Frymire (lead)