

Hawaii Ocean Time-series HOT-345 Cruise Plan

Cruise ID: KM 23-16

Vessel: R/V *Kilo Moana*, University of Hawaii

Master of the Vessel: Captain David C. Martin

Chief Scientist: Karin Björkman, University of Hawaii at Manoa

Marine Technicians: Trevor Young, Ben Duncan

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Pre-Cruise Meeting: September 29, 2023 at 1330 via Zoom.

Start pre-embarkation protocols (masking, social distancing): September 29, 2023.

COVID Testing: October 6, 0830-0900, Pier 35.

Loading: October 6 (Friday) at 0900, Pier 35.

Departure: October 7 at 0900 (Saturday, **Science personnel at UHMC by 0800**).

Arrival: October 11 at 0800.

Post-Cruise Meeting: October 12 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 October 7th 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 October 7-10.
- 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 October 10th.
- 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 October 10th for about 2 hours.

1.1 SCIENTIFIC OPERATIONS

Station

Kahe (Sta. 1)

ALOHA (Sta. 2)

WHOTS mooring station (Sta. 50)

Kaena (Sta. 6)

Underway/continuous

Activities

Weight Cast, Hyperpro cast, CTD cast (1000 m), Trace Metal CTD
Sediment traps, Primary productivity array, Gas array, Net tows,
CTD operations, Trace Metal CTD casts, aerosol sampling

One CTD cast (yo-yo to 200 m), Hyperpro, surface instrument
intercomparisons.

One near-bottom CTD cast (~ 2400 m)

ADCP, thermosalinograph, fluorometry, meteorology, C-Star

2.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
Katherine Ackerman	Graduate student	UH	USA
Hunter Adams	MATE intern	TAMU	USA
Karin Björkman	Chief Scientist	UH	SWE
Jia Cashon	Undergrad Student	UH	USA
Dan Fitzgerald	Research Associate	UH	USA
Carolina Funkey	Research Associate	UH	USA
Nicole Mathews	Undergrad Student	UH	USA
Matthew Miller	Undergrad Student	UH	USA
Sarah Nance	Undergrad Student	UH	USA
Fernando Carvalho Pacheco	Research Associate	UH	BRA
Dan Sadler	Research Associate	UH	USA
Merritt Shepherd	Graduate Student	UH	USA
Eric Shimabukuro	Research Associate	UH	USA
Tully Rohrer	Research Associate	UH	USA
Logan Tegler	Post-doc	UH	USA
Ella Wake	Undergrad Student	UH	NZL
Blake Watkins	Marine Engineer	UH	USA
Jenn Willson	MATE intern	UW	USA
Ben Duncan	OTG	UH	USA
Trevor Young	OTG	UH	USA

3.0. SUMMARY SCHEDULE

29 Sept	Pre-cruise planning meeting 1330 hrs, via Zoom.
6 Oct	COVID TESTING 0830-0900, Pier 35.
6 Oct	Equipment loading at 0900 hrs, Pier 35.
7 Oct	Depart from Pier 35 at 0900 hrs. Science personnel to UHMC by 0800.
7 Oct	Station 1 Kahe Pt. operations.
8-10 Oct	Station 2 ALOHA operations, Station 50 CTD yo-yo cast, Station 6 deep cast.
11 Oct	Arrive back to Pier 35.
12 Oct	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)

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4.2.1. Upon arrival to Station ALOHA, the Sediment Trap Array (Sect 4.2.2) (*) will be deployed. After this operation is completed, a cast at 0200 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 0626 hrs on October 8, <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 (1813 hrs on October 8). 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)

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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 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 October 10, 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 October 10, 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. Logan Tegler 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)

A near-bottom CTD cast (~2500 m) will be conducted at this location in the evening of October 10. 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 pCO₂

The ship's thermosalinograph, fluorometer and pCO₂ 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.

4.11. Aerosol sampling

In-situ sampling of sea salt aerosols at the near surface over the course of the cruise, will be conducted at a few different sampling times during the day. Atmospheric samples can be taken near the surface using a fishing pole while the ship is in motion or stationary, wind-dependent. Sampling will occur by extending a pole off the side of the ship to collect aerosol concentrations within the lowest 15 m of the atmosphere for approximately 20 minutes per time. The planned sampling will occur approximately every 4 hours during the day. This sampling will not interfere with ship's operations, and other operations such as CTD casts or recoveries of arrays. This sampling will be led by Kathrine Ackerman and Matthew Miller.

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. Hose Reel (43" x 43")
 21. 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 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, *p*CO₂ 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
35. Trace metal free block
36. 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 (156.475 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 <i>Kilo Moana</i>		HOT 345 CTD CASTS	Date: October 7-11, 2023
Cast		Samples	#Bottles
<u>Kahe Pt.</u>			
s1c1	1000 m	O ₂ , Temp, DIC/Alk, pH, Nuts, LLN, LLP, Chl a, Salts	15
<u>Station ALOHA</u>			
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	22
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	3
s2c14	1000 m	HPLC, Chl a, Salts	14
s2c15	4740 m (PO-3)	Oxygen, Salts	8
<u>WHOTS Mooring</u>			
s50c1	200 m yo-yo	DIC (1@5 m), Salts	1
<u>Kaena</u>			
s6c1	2400 m	Chl a, Salts	13

MC = Matt Church, DL = Debbie Lindell,

Ship: R/V Kilo Moana**HOT 345****Date: October 7-11, 2023**

TIME	Saturday 7/10	Sunday 8/10	Monday 9/10	Monday 10/10	Tuesday 11/10
0000		Deploy Sed Traps	VPR 1 Cast		
0100					
0200		S2C1 PP	S2C8 Gas Array		
0300				Transit Gas Array	
0400		Deploy PP Array	Deploy Gas Array	Recover Gas Array Transit Sed Traps	
0500		S2C2 PO-1 (Deep)	S2C9 Open		
0600			Transit to pump tanks Incinerator	Recover Sed Traps	
0700					
0800	All Sci. Aboard		S2C10 PSi	Transit to WHOTS (S50)	Arrive to Pier 35
0900	Depart Pier 35			S50C1 WHOTS	
1000		Trace Metal - LT 2		VPR 3 cast	
1100		S2C3 PO-2 (Begin 36 hr)	S2C11 Open		
1200	Arrive Kahe Weight Cast	Net Tow	Net Tow Net Tow	Hyperpro	
1300	Hyperpro	Hyperpro		Transit to Kaena (S6C1)	
1400	S1C1 Kahe	S2C4 PC/PN	S2C12 ATP		
1500	Trace Metal- LT 1 (Rinse)	Transit to Pump Tanks	VPR 2 Cast		
1600	Transit to ALOHA				
1700		S2C5 PPO4	S2C13 Open		
1800		Transit to PP array Recover PP array	Trace Metal - LT 3		
1900			Pump Tanks	S6C1 Kaena	
2000		S2C6 BEACH	S2C14 HPLC		
2100					
2200	Pump Tanks	Net Tow Net Tow	Net Tow	Transit to Pier 35	
2300	Arrive ALOHA	S2C7 Open	S2C15 PO-3 (Deep) (end 36 hours)		

October 8, 2023 : Sunrise 0626, Sunset 1813
(22.75, -158; <https://gml.noaa.gov/grad/solcalc/>)

6.0 HOT-345 Watch Schedule

0300-1500

Dan Fitzgerald - Watch Leader
Carolina Funkey - Water Boss
Dan Sadler
Fernando Carvalho Pacheco – Console
Sarah Nance
Jia Cashon
Jenn Willson

1500-0300

Karin Björkman – Water Boss, Chief Scientist
Eric Shimabukuro
Tully Rohrer – Console, Watch Leader
Merritt Shepherd
Nicole Mathews
Ella Wake
Hunter Adams

At Large

Kathrine Ackerman
Matthew Miller
Logan Tegler
Blake Watkins

OTG

Benjamin Duncan
Trevor Young (lead)