Hawaii Ocean Time-series
HOT-300 Operational Cruise Plan

Cruise ID: KM 18-04
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Captain Greg Steele
Chief Scientist: Tara M. Clemente, University of Hawaii
Marine Technicians: Trevor Young, Julianna Diehl

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Pre-Cruise: February 16th, 2018 @1330 in the Moore Conference Center, C-MORE Hale.
Loading: February 23rd, 2018 @0900
Departure: February 24th, 2018 @0900 (**Science personnel on board by 0800**).
Arrival: February 28th, 2018 @0800
Post-Cruise: February 28th, 2018 @1000

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. Three 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 24th 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 24th – 27th.
3) Station 52, the site of WHOTS-14 Mooring (anchor position 22° 40.01'N 157° 57.09'W) will be occupied on for about one hour on February 27th.
4) Deep trap recovery (anchor position at 22° 51.971'N, 157° 53.167'W). Recovery of the sediment trap is expected to take approximately 3 hours, with return to the surface expected to take an hour on February 27th.

NOTE: No operations at Station 6, Kaena, due to time requirements for the recovery of the deep sediment trap.

1.1 SCIENTIFIC OPERATIONS

Station	Activities
Kahe (Sta. 1)	Weight Cast, Hyperpro cast, CTD cast (1000 m)
ALOHA (Sta. 2)	Sediment traps, gas array, WireWalker, net tows, CTD operations, primary productivity measurements, optics casts, recovery of deep moored traps, misc. experiments.

WHOTS mooring station (Sta. 52)	One CTD cast (yo-yo to 200 m), surface instrument intercomparisons.
Underway/continuous	ADCP, thermosalinograph, fluorometry, meteorology

2.0. SCIENCE PERSONNEL

Participant	**Title**	**Affiliation**	**Citizenship**
Tara Clemente – Chief Scientist	Research Associate	UH/SCOPE	USA
Karin Bjorkman	Scientist	UH	Sweden
Tim Burrell	Research Associate	UH/SCOPE	New Zealand
Marion Carlson	Scientist	Simons Foundation	USA
Sara Ferron- Smith	Scientist	UH/SCOPE	USA
Carolina Funkey	Research Associate	UH	USA
Eric Grabowski	Research Associate	UH	USA
Sarah Hu	PhD Candidate	USC/SCOPE	USA
David Karl	Scientist	UH/CMORE/SCOPE	USA
Andrew King	Research Associate	UH	USA
Kelsey Maloney	Undergraduate Student	UH	USA
Lisa Mesrop	Research Technician	USC/SCOPE	USA
William Miller	Scientist	UG	USA
Svetlana Natarov	Research Assistant	UH	USA
Kellen Rosburg	Research Associate	UH	USA
Chris Sabine	Scientist	UH	USA
Dan Sadler	Research Associate	UH	USA
Eric Shimabukuro	Research Associate	UH/SCOPE	USA
Jefrey Snyder	Marine Technician	UH	USA
Ryan Tabata	Research Associate	UH/SCOPE	USA
Avery Tatters	Postdoctoral Scholar	USC/SCOPE	USA
Carleigh Volbrecht	Volunteer	UH	USA
Blake Watkins	Marine Engineer	UH	USA
Angelicque White	Scientist	OSU/SCOPE	USA
Chris Winn	Scientist	HPU	USA
Julianna Diehl	Marine Technician	OTG	USA
Trevor Young	Marine Technician	OTG	USA

3.0. SUMMARY SCHEDULE

16 February	Pre-cruise planning meeting 1330 hrs, Moore Conference Center, C-MORE Hale.
23 February	Ship loading at 0900 hrs.
24February	Depart from Pier 35 at 0900 hrs. **Science personnel on-board by 0800.**
24 February	Station 1 Kahe Pt. operations.
25-27 February	Station ALOHA operations, Station 52 CTD yo-yo cast, Deep trap recovery.
28 February	Arrive back to Pier 35. Full offload. Post-cruise meeting.

4.0. OPERATIONAL PLANS

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

A 1000 lb. weight-test cast to 1000m, one CTD cast to 1000 m and a Hyperpro cast (Sect. 4.2.7) will be conducted at this location on February 24th. The ships A-frame and trawl 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 traps will be deployed (Sect. 4.2.2). Once the sediment traps are deployed, the Wirewalker will be deployed (Sect. 4.2.3). After these operations are completed, one 200-m cast will be conducted to collect water for the Primary Production Array. Following this, the Primary Production array will be deployed (4.2.4). 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: 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

Upon arrival to Station ALOHA the floating sediment traps will be deployed at a location within Station ALOHA, to be determined by local current conditions. The array will be deployed from the back of the deck thru 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 three crosses with 12 particle interceptor traps (PIT) each at 150m.

The array will drift for about 56 hours before recovery. The array is equipped with 1 ARGOS satellite transmitter (platform #: 60484), 1 Novatech Iridium beacon (platform #: 200), strobe lights, a radio transmitter (channel 74: 156.725 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 prepare to deploy the wirewalker.

4.2.3 Wirewalker deployment

A Wirewalker (Del Mar Oceanographic) will be deployed at Station ALOHA to take hydrographic and optical observations in the upper 400 m of the water column. The instrument is approximately 1.5 m long and 0.6 m wide and weighs approximately 30 Kg. The instrument will be deployed on a wire with a 40 Kg bottom weight and a surface buoy with strobe light and Pacific Gyre positioning system (ID: DMO-GLBCN-0003 or DMO-GLBCN-0004), Xeos 56010, Iridium (platform #: 704320).

The Wirewalker will be deployed in close proximity to the sediment traps, so that the two arrays drift in similar directions. The instrument will stay in the water for approximately 56 hours. Deployment and recovery will be conducted from the back deck through the A-frame and using the SeaMac winch, each operation will take 30 to 60 min. Blake Watkins will be in charge of this operation with 2 or 3 members of the science party. Two ABs will be required to operate the A-frame and winch respectively.

After deployment of the Wirewalker, one 200m CTD cast shall be conducted and the ship shall prepare to deploy the Primary Productivity Array.

4.2.4 Primary production experiment

Samples for the primary productivity experiment will be collected from the rosette. Before dawn (Sunrise 0656 hrs on February 25th), a free drifting incubation array will be deployed from the back of the deck

thru the A-frame and using the SeaMac winch. The array is equipped with two ARGOS satellite transmitters (platform # 84857), Novatech Iridium beacon (platform #: 100), strobe lights and a radio transmitter (channel 73: 156.675 MHz). Positions of the array will be emailed to argosfix@km.soest.hawaii.edu , password: argosfix. 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 (1834 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.

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

4.2.5. 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 CTD winch and A-frame 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 3 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 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, Tim Burrell)**.

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 starboard stern rail using the small crane and the Sea-Mac winch. The array is equipped with two ARGOS satellite transmitters (platform # 84857), Novatech Iridium beacon (platform #: 100), strobe lights and a radio transmitter (channel 73: 156.675 MHz). Positions of the array will be emailed to argosfix@km.soest.hawaii.edu, password: argosfix. 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.

4.2.7. 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, second and fourth 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. 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. B. Watkins will be in charge of these operations.

4.2.9. Caron Net Tows

Short (5-10 min) drift tows (hand-held plankton tows) will be conducted in between normal HOT Operations. 3-4 net tows will occur per day, as time allows.

4.2.10. Optics

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 capstan will be needed for this operation.

4.2.11. Automated Trace Element Sampler (ATE)

On the morning of February 26th, 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, Sediment Trap Array and Wire Walker recovery

In the morning of February 27th, after the optics cast has been completed, the ship shall transit for the recovery of the Gas Array. The small crane and the Sea-Mac winch will be needed to retrieve the sediment trap array. After the Gas Array is recovered, the ship shall transit to recover the floating sediment trap array. On completion of sediment trap array recovery, the ship shall transit to recover the Wirewalker. After the Wirewalker is recovered, the ship shall transit to Station 52. Upon arrival at Station 52 a Hyperpro cast, Caron net tow, one 200 m CTD yo-yo cast and ADCP inter comparisons will be conducted.

4.4 Station 52 - WHOTS-14 Mooring

The anchor position of the WHOTS-14 mooring is 22° 40.0154' N, 157° 57.0915' 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 mooring on February 27th for subsurface instrument intercomparison. This cast should be conducted downwind, down current, and about 200 m from the mooring.

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 mooring. Once the yo-yo cast is completed, ADCP intercomparisons will be run between the shipboard ADCP system and the moored instrument on the WHOTS-14 mooring line. These comparisons should also be conducted downwind, down current, and about 200 m from the mooring.

4.5 Deep Sediment Trap Recovery

Following the completion of ADCP comparisons, the ship shall transit to the location of the deep sediment trap anchor at 22°51.971' N, 157°53.167' W. Recovery of the sediment trap is expected to take approximately 3 hours, with return to the surface expected to take an hour. The array is equipped with a radio transmitter for location (156.625MHz)

Blake Watkins will be in charge of this operation with 2 or 3 members of the science party. Two ABs will be required to operate the A-frame and winch respectively.

4.6. Acoustic Doppler Current Profiler

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

4.6.1. Lowered Acoustic Doppler Current Profiler

The HOT rosette configuration includes a lowered-ADCP for current measurements on down- and up-cast. The LADCP, operating in single ping at 4 Hz, will record measurements internally. These measurements will then be downloaded after each cast via an RS232-to-ethernet connection. This will require direct connection to the ADCP after each cast, with data download before the next cast.

4.7. Thermosalinograph and Fluorometer

The ship's thermosalinograph and fluorometer sampling the uncontaminated seawater supply system will be in operation during the duration of the cruise while the ship is outside of Pier 35 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, Fluorometer, and meteorological suite operations.

4.8 Handover Tag-up

As available, all watch leaders, water bosses, and on-duty OTG reps are to report to the staging bay 15 minutes prior to science watch handover. The off-going shift will brief the on-coming shift of any anomalies, issues, or weather conditions encountered during the shift and a brief review the on-coming shift's activities.

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 vans (#23) with assorted equipment for radioisotope and general use. One 10 ft. blue storage van (PO) for equipment and spare storage.
4. Distilled, deionized water and all required chemicals and isotopes
5. Large vacuum waste containers
6. Liquid nitrogen dewars
7. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights, line, sediment traps and crosses.
8. Drifting primary production array with strobe lights, satellite and radio transmitters, floats, weights, line primary production bottles and spreader bars.
9. Drifting net trap array with strobe lights, satellite and radio transmitters, floats, weights, line, framed net, acoustic release and pinger.
10. Drifting diazotrophy growth rate array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and long mounting bars.
11. Drifting gas array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and short mounting bars.
12. Empty wire baskets for Deep Moored Sediment Trap floats upon recovery.
13. Large on deck incubator
14. CARON Incubator
15. Oxygen titration system
16. Plankton nets and towing lines
17. Desktop and laptop personal computers
18. Assorted tools

19. All required sampling bottles
20. Pertinent MSDS
21. Wirewalker

5.2. 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 the back deck for one 10 ft van **(Blue Equipment van)**
6. Space on upper deck for one van **(#23)**
7. Space on deck for ~6 deck baskets of array gear
8. Space on upper deck for sea water incubators
9. Small capstan (~ 10 m/min)
10. SeaMac Winch
11. Radio direction finder
12. Hand-held VHF transceivers
13. Shackles, sheaves, hooks and lines
14. Precision depth recorder
15. Shipboard Acoustic Doppler Current Profiler
16. Thermosalinograph, pCO_2 system, and Fluorometer
17. Meteorological suite
18. Grappling hooks and line
19. Navlink2 PC or equivalent
20. Running fresh water and seawater, hoses
21. Uncontaminated seawater supply
22. -80°C Freezer
23. 4°C Refrigerator and -20°C Freezer
24. Distilled, deionized water system
25. Electronic mail system
26. GPS system
27. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, and access to real-time data through the network.
28. OTG's 24-place rosette, and 24 12-l water sampling bottles (to be used as spare)
29. ~1300 lb weight
30. Remote CTD dbar pressure display in the winch operator area.
31. Monitor in CTD Lab displaying ship coordinates, bottom depth and GMT.
32. OTG's transmissometer

Ship: R/V *Kilo Moana* **HOT 300 CTD CASTS** **Date: February 24-28, 2018**

Cast		Samples	#Bottles
Kahe Pt.			
s1c1	1000 m	O_2, Temp, DIC/Alk, Nuts, Chl a, LLN, LLP, DOC, FCM, Salts WM (1@5m, 1@ DCM, 1@O2 Min)	18
Station ALOHA			
s2c1	200 m	Primary Production, SF-S(pb 3@ 5, 25, 45, 75, 100, 125), Salts	22
s2c2	500m	DK Mixing Experiment (7@15m, 2@ 500m)	9
s2c3	4740 m (PO-1)	O_2, Temp, DOC, DIC/Alk, Nuts, Salts, WM (pb 1L Profile @ TBD)	24
s2c4	1000 m (PO-2)	O_2, Temp, DOC, DIC/Alk, Nuts, Salts	24
s2c5	1000 m	PC/PN, DNA(1@5,25,45,75), Salts	18
s2c6	1000 m	PPO4, SF-S(1@5, 25), Salts	16
s2c7	1000 m (BEACH)	O_2, Temp, DIC/Alk, Nuts, LLN, LLP, DOC, Keeling, Quay, Salts, SF-S (1@5,pb@25)	24
s2c8	1000 m	PUR, SF-S(1@5, 25), DNA(1@,100,125,150,175), Salts	16
s2c9	1000 m	Gas Array(3@5,25,45,75,100,125), SF-S(1@5, 25), Salts	22
s2c10	1000 m	DNA(1@200,225,250,275), SF-S(1@5, 25), MC (1@5, 25, 45, 75, 100, 125, 150, 175), SF-S (1 @25, 75, DCM), Salts	19
s2c11	1000 m	PSi, SF-S(1@5, 25), KW-B(1@5,25,45), Salts	15
s2c12	1000 m	SF-S (1@5,25,45,75,100,125, 150,200,300,400, MLD-5, MLD+5), SF-S(1@5, 25), Salts	16
s2c13	1000 m	ATP, DNA(1@300,400,500,770), SF-S(1@5, 25), Salts	17
s2c14	1000 m	SW(1@5,25,45,75,100,125,150,175, 200, 300, 400, 800), SF-S(pb SW 1@5, 25), AK(6@1000), Salts	20
s2c15	1000 m	HPLC, Chl a, Salts	14
s2c16	4740 m (PO-3)	Oxygen, DNA(1@1000,2000,3000,4000), WM (1@5m, 1@ DCM, 1@O2 Min, 1@ Bottom Depth ~4740), Salts	16
WHOTS Mooring			
s52c1	200 m yo-yo	DIC/TA(1@5), KW-B(1@5,25,45), SF-S (1 @25, 75, DCM), QL (1@25)	8

MC=Matt Church, **SW**=Sam Wilson, **SF-S=**Sara Ferrón-Smith, **KW-B**=Kate Watkins-Brandt, **AK**=Andrew King
WM= William Miller, **DK**= Dave Karl, **QL** = Qian Li

Ship: R/V *Kilo Moana* HOT 300 Date: February 24-28, 2018

TIME	Sat. 2/24	Sun. 2/25	Mon. 2/26	Tues. 2/27	Wed. 2/28
0000		Deploy Sed Trap	Transit to pump tanks		
0100		Deploy WireWalker			
0200		S2C1 PP	S2C9 Gas		
0300				Optics	
0400		Deploy PP Array	Deploy Gas Array		
0500		S2C2 Net Tow (Caron)	S2C10 Open	Transit gas array	
0600		S2C3 PO-1	Net Tow (Caron)	Recover gas array Transit sed traps	
0700				Recover sed traps	
0800	All Sci. Aboard		S2C11 PSi	Transit WireWalker	Arrive Pier 35
0900	Depart Pier 35		Transit to pump tanks	Recover WireWalker	
1000	Arrive Kahe (10:30) Weight Cast	Net Tow (Caron)	ATE Net Tow (Caron)	Transit St. 52	
1100	Hyperpro	S2C4 PO-2 (Begin 36 hr)	S2C12 Open		
1200	Net Tow (Caron) S1C1 Kahe	Net Tow	Net Tow Net Tow	HyperPro Net Tow (Caron)	
1300		HyperPro		S52C1 WHOTS	
1400	Transit ALOHA	S2C5 PC/PN	S2C13 ATP	ADCP Inter-comp	
1500		Transit to pump tanks		Transit deep trap	
1600		Net Tow (Caron) S2C6 PPO4	Net Tow (Caron)	Deep trap recovery	
1700			S2C14 Open		
1800		Recover PP array	Transit to pump tanks		
1900				Transit Pier 35	
2000		S2C7 BEACH	S2C15 HPLC		
2100		Net Tow (Caron)	Net Tow (Caron)		
2200		Net Tow Net Tow	Net Tow		
2300	Arrive ALOHA	S2C8 PUR	S2C16 PO-3 (end 36 hours)		

February 25th: Sunrise 0656, Sunset 1834

6.0 HOT-300 Watch Schedule

0300-1500

Tara Clemente - Chief Scientist
Dan Sadler - Water Boss
Chris Sabine – Alt Tag
Eric Grabowski – Alt Tag
Jefrey Snyder - Watch Leader, Tag
Svetlana Natarov – Console
Eric Shimabukuro – Tag
Sara Ferron Smith – Alt Tag
Kelsey Maloney

1500-0300

Andrew King – Tag
Chris Winn – Alt Tag
Karin Bjorkman – Water Boss
Tim Burrell – Watch Leader
Ryan Tabata – Tag
Kellen Rosberg – Console
Carolina Funkey – Alt Tag
Carleigh Volbrecht

At Large

Marion Carlson
Sarah Hu
David Karl
Lisa Mesrop
William Miller
Avery Tatters
Blake Watkins
Angelicque White