Hawaii Ocean Time-series
HOT-306 Cruise Plan

Cruise ID: KM 18-17
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Captain Joey Daigle Jr.
Chief Scientist: Fernando Santiago-Mandujano, University of Hawaii
Marine Technicians: Jeff Koch, Julianna Diehl

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Fernando Santiago-M Cell Number: (808) 375-5159

Pre-Cruise: October 4th, 2018 @1330 in the Moore Conference Center, C-MORE Hale.
Loading: October 10th @ 0900, Pier 35.
Departure: October 11th, 2018 @0900 (**Science personnel on board by 0800**).
Arrival: October 15th, 2018 @0800
Post-Cruise: October 15th, 2018 @1000 in KM Conference Room

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 October 11th 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 October 12th – 14th.
3) Station 50, the site of WHOTS-15 Mooring (anchor position 22° 46.045'N 157° 53.888'W) will be occupied for about one hour on October 14th.

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, Misc. experiments.
WHOTS mooring station (Sta. 50)	One CTD cast (yo-yo to 200 m), surface instrument intercomparisons. Small boat operations to fix pCO_2 equilibrator
Deep sediment trap site	Recover deep sediment trap.

Underway/continuous	ADCP, thermosalinograph, fluorometry, meteorology, SeaFlow, C-Star, Imaging FlowCytobot (IFCB)

2.0. SCIENCE PERSONNEL

Participant	**Title**	**Affiliation**	**Citizenship**
Emily Aguirre	PhD. Candidate	USC/SCOPE	USA
Kendra Babcock	Research Associate	UH	USA
Macarena Burgos	Scientist	UCádiz	Spain
Eric Grabowski	Research Associate	UH/SCOPE	USA
David Caron	Scientist	USC/SCOPE	USA
Tara Clemente	Research Associate	UH/SCOPE	USA
Carolina Funkey	Research Associate	UH	USA
Vivian Merk	Postdoctoral Scholar	USC/SCOPE	USA
Lisa Mesrop	Research Associate	USC/SCOPE	USA
Sara Turner	Undergraduate Student	UH	USA
Mariam Moreno	Undergraduate Student	UH	USA
Courtney Morgan	Undergraduate Student	UH	USA
Svetlana Natarov	Research Assistant	UH	USA
Dan Sadler	Research Associate	UH	USA
Fernando Santiago-Mandujano – Chief Scientist	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
Ksenia Trifonova	Research Associate	UH	Germany
Blake Watkins	Marine Engineer	UH	USA
Tully Rohrer	Research Associate	UH	USA
Julianna Diehl	Marine Technician	OTG	USA
Jeff Koch	Marine Technician	OTG	USA

3.0. SUMMARY SCHEDULE

4 October	Pre-cruise planning meeting 1330 hrs, Moore Conference Center, C-MORE Hale.
10 October	Ship loading at 0900 hrs, Pier 35.
11 October	Depart from Pier 35 at 0900 hrs. **Science personnel on-board by 0800.**
11 October	Station 1 Kahe Pt. operations.
12-14 October	Station ALOHA operations, Station 50 CTD yo-yo cast, recover deep sed. traps.
15 October	Arrive back to Pier 35. Full offload. Post-cruise meeting.
15 October	Post-cruise meeting at 1000 hrs. KM Conference Room.

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, a Hyperpro cast (Sect. 4.2.7), and one CTD cast to 1000 m (4.2.5) will be conducted at this location on October 11th. 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 Wirewalker will be deployed (Sect. 4.2.2). Once the Wirewalker is deployed, the Sediment Traps will be deployed (Sect. 4.2.3). After these operations are completed, one 1000-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 Wirewalker deployment

Upon arrival to Station ALOHA a Wirewalker (Del Mar Oceanographic) will be deployed 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 51020, Iridium (platform #: 704320).

The Wirewalker 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 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. Two ABs will be required to operate the A-frame and winch respectively. B. Watkins will be in charge of this deployment.

After deployment of the Wirewalker, the ship shall prepare to deploy the sediment trap array.

4.2.3. Sediment trap array deployment

The floating sediment traps will be deployed in close proximity to the Wirewalker, so the two arrays drift in a similar direction. 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 one cross with 12 particle interceptor traps (PIT) 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. B. Watkins will be in charge of this deployment.

After deployment of the sediment trap array, one 1000m 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 0628 hrs on October 12th), 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. 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 (1809 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. B. Watkins will be in charge of this deployment.

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 **(Tara Clemente, Eric Shimabukuro)**.

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 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 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. B. Watkins will be in charge of 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, 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. Optics

An optical package including a SeaBird Seacat with temperature, conductivity, and pressure sensors, a Wetlabs ECO triplet measuring g backscatter, chlorophyll fluorescence, and CDOM fluorescence and a LISST particle size and distribution analyzer will be deployed during the cruise. Each deployment will consist of three 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.

4.2.9. 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. B. Watkins will be in charge of these operations.

4.2.10. Caron Hand-held 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.

4.3. Gas Array, Sediment Trap Array and Wire Walker recovery

In the morning of October 14th, after the optics cast has been completed, 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 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. B. Watkins will be in charge of these operations. After the Wirewalker is recovered, the ship shall transit to Station 50. Upon arrival at Station 50 a Hyperpro cast, Caron hand-held net tow, one 200 m CTD yo-yo cast and ADCP inter comparisons will be conducted.

4.4 Station 50 - WHOTS-15 Mooring

The anchor position of the WHOTS-15 mooring is 22° 46.045'N 157° 53.888'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 October 14th 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-15 mooring line. These comparisons should also be conducted downwind, down current, and about 200 m from the mooring.

After these operations are completed, a small-boat operation shall be conducted to fix an instrument in the WHOTS buoy.

4.4.3 Operations to fix the WHOT's buoy pCO_2 equilibrator

If weather conditions are favorable, a small-boat will be launched to take J. Snyder to the WHOTS buoy, where he will try to fix the pCO_2 equilibrator.

After operations at Station 50 are completed, the ship shall transit to recover the deep sediment traps.

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°51.285'N, 157°53.491'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)

B. 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 600 kHz lowered-ADCP (LADCP) for current measurements on down- and up-cast. The LADCP, operating in single ping mode, will record measurements internally at a rate of 4 Hz. 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 Honolulu 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.

4.7.1 SeaFlow, Inline C-Star Transmissometer and Imaging FlowCytobot (IFCB)

In addition to the continuous thermosalinograph and fluorometer sampling, the SeaFlow, an inline C-Star Transmissometer, and the IFCB will sample continuously from the uncontaminated seawater supply system throughout the duration of the cruise while the ship is outside of Honolulu Harbor. Access to real-time underway data through the ships network is required. The SCOPEOps technicians and UH personnel will be in charge of these instruments and 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 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. qDrifting gas array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and short mounting bars.
10. Drifting Wirewalker array with surface buoy, strobe lights, satellite transmitters, floats, weights, 400m and cable.
11. CARON Incubator
12. Oxygen titration system
13. Plankton nets and towing lines
14. Desktop and laptop personal computers
15. Assorted tools
16. All required sampling bottles

17. Pertinent MSDS
18. Wirewalker
19. SeaFlow
20. Inline C-Star Transmissometer
21. Imaging FlowCytobot (IFCB)
22. McLane pump and large incubator
23. 20 l carboy for Esther Mak water sample

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

Ship: R/V *Kilo Moana* **HOT 306 CTD CASTS** **Date: October 11-15, 2018**

Cast		Samples	#Bottles
Kahe Pt.			
s1c1	1000 m	O_2, Temp, DIC/Alk, Nuts, Chl a, LLN, LLP, DOC, FCM, Salts	24
Station ALOHA			
s2c1	200 m	Primary Production, SF-S(pb 3@ 5, 25, 45, 75, 100, 125) and O2(1@15), Salts	23
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	24
s2c4	1000 m	PC/PN, DNA(1@5,25,45,75), Salts	18
s2c5	1000 m	PPO4, SF-S(1@5, 25) and O2(1@15), Salts	17
s2c6	1000 m (BEACH)	O_2, Temp, DIC/Alk, Nuts, LLN, LLP, DOC, Keeling, Quay, Salts, SF-S (1@5,pb@25)	24
s2c7	1000 m	PUR, SF-S(1@5, 25), DNA(1@,100,125,150,175), Salts	16
s2c8	1000 m	Gas Array(3@5,25,45,75,100,125), SF-S(1@5, 25), Salts	22
s2c9	1000 m	DNA(1@200,225,250,275), SF-S(1@5, 25) and O2(1@15), MC (1@5, 25, 45, 75, 100, 125, 150, 175), Salts	17
s2c10	1000 m	PSi, SF-S(1@5, 25), Salts	12
s2c11	1000 m	SF-S(1@5, 25), Salts	4
s2c12	1000 m	ATP, DNA(1@300,400,500,770), SF-S(1@5, 25), Salts	17
s2c13	1000 m	SW(1@5,25,45,75,100,125,150,175, 200, 300, 400, 600, 800), SF-S(1@5, 25) and O2(1@15), Salts	16
s2c14	1000 m	HPLC, Chl a, Salts	14
s2c15	4740 m (PO-3)	Oxygen, DNA(1@1000,2000,3000,4000), Salts	12
WHOTS Mooring			
s50c1	200 m yo-yo	DIC/TA(1@5), EM (2@15)	3

MC=Matt Church, **SW**=Sam Wilson, **SF-S=**Sara Ferrón-Smith, **EM**=Esther Mak

Ship: R/V *Kilo Moana* HOT 306 Date: October 11-15, 2018

TIME	Thurs. 10/11	Fri. 10/12	Sat. 10/13	Sun. 10/14	Mon. 10/15
0000		Deploy WireWalker	Transit to pump tanks		
0100		Deploy Sed Trap			
0200		S2C1 PP	S2C8 Gas		
0300				Optics	
0400		Deploy PP Array	Deploy Gas Array		
0500		Net Tow (Caron)	S2C9 Open	Transit Gas Array	
0600		S2C2 PO-1	Net Tow (Caron)	Recover Gas Array Transit Sed Traps	
0700				Recover Sed Traps	
0800	All Sci. Aboard		S2C10 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)	Net Tow (Caron)	Transit St. 50	
1100	Hyperpro	S2C3 PO-2 (Begin 36 hr)	S2C11 Open		
1200	Net Tow (Caron) S1C1 Kahe	Net Tow	Net Tow Net Tow	HyperPro Net Tow (Caron)	
1300		HyperPro		S50C1 WHOTS	
1400	Transit ALOHA	S2C4 PC/PN	S2C12 ATP	ADCP Inter-comp/ Small-boat ops.	
1500		Transit to pump tanks		Transit to deep sediment traps	
1600		Net Tow (Caron)	Net Tow (Caron)	Recover deep sediment traps	
1700		S2C5 PPO4	S2C13 Open		
1800		Recover PP array	Transit to pump tanks		
1900				Transit to Pier 35	
2000		S2C6 BEACH	S2C14 HPLC		
2100		Net Tow (Caron)	Net Tow (Caron)		
2200		Net Tow Net Tow	Net Tow		
2300	Arrive ALOHA	S2C7 PUR	S2C15 PO-3 (end 36 hours)		

October 12th: Sunrise 0628, Sunset 1809

6.0 HOT-306 Watch Schedule

0300-1500

Tara Clemente – Watch Leader
Eric Grabowski – Tag
Dan Sadler – Water Boss, Alt. Tag
Jefrey Snyder –Tag
Ksenia Trifonova – Console
Macarena Burgos
Sara Turner

1500-0300

Kendra Babcock
Eric Shimabukuro – Watch Leader, Tag
Carolina Funkey – Water Boss
Svetlana Natarov– Console
Fernando Santiago-Mandujano – Chief Scientist, Alt. Tag
Ryan Tabata – Tag
Mariam Moreno

0900-2100

Tully Rohrer
Courtney Morgan

At Large

Emily Aguirre
David Caron
Vivian Merk
Lisa Mesrop
Avery Tatters
Blake Watkins