Papahānaumokuākea Marine National Monument

RESEARCH Permit Application

NOTE: ***This Permit Application (and associated Instructions) are to propose activities to be conducted in the Papahānaumokuākea Marine National Monument. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Papahānaumokuākea Marine National Monument (Monument).***

ADDITIONAL IMPORTANT INFORMATION:

- Any or all of the information within this application may be posted to the Monument website informing the public on projects proposed to occur in the Monument.

- In addition to the permit application, the Applicant must either download the Monument Compliance Information Sheet from the Monument website OR request a hard copy from the Monument Permit Coordinator (contact information below). The Monument Compliance Information Sheet must be submitted to the Monument Permit Coordinator after initial application consultation.

- Issuance of a Monument permit is dependent upon the completion and review of the application and Compliance Information Sheet.

INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED

Send Permit Applications to:
NOAA/Inouye Regional Center
NOS/ONMS/PMNM/Attn: Permit Coordinator
1845 Wasp Blvd, Building 176
Honolulu, HI 96818
nwhipermit@noaa.gov
PHONE: (808) 725-5800 FAX: (808) 455-3093

<u>SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.</u>

Papahānaumokuākea Marine National Monument
Permit Application Cover Sheet

This Permit Application Cover Sheet is intended to provide summary information and status to the public on permit applications for activities proposed to be conducted in the Papahānaumokuākea Marine National Monument. While a permit application has been received, it has not been fully reviewed nor approved by the Monument Management Board to date. The Monument permit process also ensures that all environmental reviews are conducted prior to the issuance of a Monument permit.

Summary Information

Applicant Name: Dr. Christopher Winn and Dr. Samuel E. Kahng
Affiliation: Hawaii Pacific University

Permit Category: Research
Proposed Activity Dates: April 2015 to April 2016
Proposed Method of Entry (Vessel/Plane): Vessel or Plane
Proposed Locations: The details of the research trip are not yet planned, this research trip is opportunistic sampling joining another group's cruise. Potential to visit any of the Northwestern Hawaiian Islands: Kure Atoll, Midway Atoll, Pearl and Hermes Atoll, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island.

Estimated number of individuals (including Applicant) to be covered under this permit: 5

Estimated number of days in the Monument: 30 days

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

help Monument managers assess and understand the impact of ocean acidification. We are working to develop a simple chemical method to assess changes in reef metabolism. This proposed research will collect preliminary observations using this new method to monitor coral reef metabolism. When implemented, this approach has the potential to provide managers with a simple and inexpensive procedure to assess the response of coral reef ecosystems to changes in ocean chemistry. A secondary aim of this effort is to measure the levels of inorganic and organic metabolism over the coastal reefs to quantify their effects on the inorganic carbon system of coastal waters. This project aims to examine the spatial gradient of carbonate parameters from the shallow fore-reef (~20 m depth) on the island shelves to the deep open ocean (~500 m depth) to investigate the effect of biological processes on the carbon system throughout the diel cycle. The latitudinal gradient of carbonate parameters along the NWHI island chain will also be assessed with respect to the island mass effect.

b.) To accomplish this activity we would ….
collect water samples at shallow depths (<10m) in the waters inside the atolls and nearshore to the island masses. The procedure involves the collection of water from the nearshore environment as close to sunrise as possible and as close to sunset as possible. Two or three replicate 250 mL subsamples will be collected into Pyrex glass bottles. 100 microliters (about one drop) of a saturated mercuric chloride solution will be added to each bottle and the bottles will be sealed with apeizon grease for transport to our laboratory in Waimanalo, Oahu. The temperature and salinity of the water sample will be measured with a simple hand-held conductivity and temperature meter called a YSI. This sampling method will be conducted in the morning and evening each day for the duration of our time in the PMNM. To better analyze the carbonate chemistry data set surface ocean current data will be measured using a drifter drogue each day of sampling and will be recorded continuously by an ADCP positioned on the sand seafloor adjacent to the sampling location for the duration of sampling. In tandem with the drifter drogue fluorescein disodium salt (fluorescing dye) may be used to determine directionality and speed of surface current. Continuous CTD measurements will be taken from the ship to assess the spatial and temporal gradients of carbonate chemistry parameters surrounding the islands. Discrete water samples will be taken at selected depths during the CTD casts to test in a laboratory setting to verify any trends seen in the CTD data.

c.) This activity would help the Monument by …
developing a simple method to assess change in reef ecosystems in reponse to changing ocean chemistry. Assessing the island mass effect to determine the spatial gradients effect on the coral reef processes surrounding the coastal waters of the NWHI. Examining the gradients of carbonate parameters from the open ocean to coastal marine habitats is critical for forecasting any future impact of climate change on the coral reef ecosystems of the Papahānaumokuākea Marine National Monument. An additional objective of this project involves developing appropriate standard operating procedures (SOPs) for conducting field sampling and performing analytical laboratory measurements.

Other information or background:

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Dr. Christoper D. Winn and Dr. Samuel E. Kahng

Title: Associate Professor of Oceanography

1a. Intended field Principal Investigator (See instructions for more information):
Dr. Christopher D. Winn and Dr. Samuel E. Kahng

2. Mailing address (street/P.O. box, city, state, country, zip): Oceanic Institute
[redacted]

For students, major professor's name, telephone and email address: Not applicable.

3. Affiliation (institution/agency/organization directly related to the proposed project):
Hawaii Pacific University
[redacted]

4. Additional persons to be covered by permit. List all personnel roles and names (if known at time of application) here (e.g. John Doe, Research Diver; Jane Doe, Field Technician):
Ms. Crystal Coughlin, HPU Graduate Student
Mr. Roman Battisti, HPU Graduate Student
HPU Graduate Student to be determined

Section B: Project Information

5a. Project location(s):

		Ocean Based	
☒ Nihoa Island	☒ Land-based	☒ Shallow water	☒ Deep water
☒ Necker Island (Mokumanamana)	☒ Land-based	☒ Shallow water	☒ Deep water
☒ French Frigate Shoals	☒ Land-based	☒ Shallow water	☒ Deep water
☒ Gardner Pinnacles	☒ Land-based	☒ Shallow water	☒ Deep water
☒ Maro Reef			
☒ Laysan Island	☒ Land-based	☒ Shallow water	☒ Deep water
☒ Lisianski Island, Neva Shoal	☒ Land-based	☒ Shallow water	☒ Deep water
☒ Pearl and Hermes Atoll	☒ Land-based	☒ Shallow water	☒ Deep water
☒ Midway Atoll	☒ Land-based	☒ Shallow water	☒ Deep water
☒ Kure Atoll	☒ Land-based	☒ Shallow water	☒ Deep water
☐ Other			

NOTE: There is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description:
Sampling will be restricted to shallow surface and subsurface water. We will not be collecting live animals or any other samples except water samples within PMNM.

5b. Check all applicable regulated activities proposed to be conducted in the Monument:

☒ Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving Monument resource
☒ Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
☐ Anchoring a vessel
☐ Deserting a vessel aground, at anchor, or adrift
☒ Discharging or depositing any material or matter into the Monument
☐ Touching coral, living or dead
☐ Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the Monument
☐ Attracting any living Monument resource
☐ Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)
☐ Subsistence fishing (State waters only)
☒ Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

6. Purpose/Need/Scope ***State purpose of proposed activities:***
Our research is designed to evaluate a newer non-invasive method to assess change in coral reef ecosystem metabolism in the NWHI. It is important that we collect water this is uncontaminated by engine exhaust or other impacts from activities on the small boats. We are not certain of the number of people on the small boat and the activities that will be taking place over the side of the boat. We are therefore requesting that we be allowed to swim a short distance away from the boat if neede to ensure that we will be able to collect samples uncontaminated by boat engine exhaust without interfering with other small boat operations.

*Considering the purpose of the proposed activities, do you intend to film / photograph federally protected species? Yes ☐ No ☒

For a list of terrestrial species protected under the Endangered Species Act visit:
http://www.fws.gov/endangered/
For a list of marine species protected under the Endangered Species Act visit:
http://www.nmfs.noaa.gov/pr/species/esa/
For information about species protected under the Marine Mammal Protection Act visit:
http://www.nmfs.noaa.gov/pr/laws/mmpa/

7. Answer the Findings below by providing information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Monument:

The Findings are as follows:

a. How can the activity be conducted with adequate safeguards for the cultural, natural and historic resources and ecological integrity of the Monument?
Our collection of small volumes (less than 14 gallons) of surface and subsurface seawater from shallow water regions will not impact the emergent islands or submerged reefs in any way. No macroscopic animals will be collected as part of our work. Mercuric Chloride is used to preserve water samples for analysis in a carbonate chemistry laboratory in Waimanlo, Oahu. One tenth of one milliliter of Mercuric Chloride will be added to each sample bottle after the sample is collected and no Mercuric Chloride will be released into monument waters. The collection of surface water samples in 250 mL aliquots should not impart on any cultural or historic resources within PMNM.

b. How will the activity be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument cultural, natural and historic resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects?

We have all attended the cultural briefing in the past and appreciate the cultural significance of the Northwestern Hawaiian Islands to Native Hawaiians as a sacred place. Native Hawaiians have depended on the ocean as a resource for sustenance and cultural activities and we will respect this during our trip to the PMNM. We look forward to expanding our knowledge of this topic as we plan our trip and meet with PMNM staff. Coral reefs and the ecosystem surrounding the Hawaiian Archipelago are an important natural resource as well as a cultural asset for Native Hawaiians and all U. S. citizens. These massive calcium carbonate structures may be severely damaged by the slowly declining pH in the global ocean. The effects of ocean acidification on the subtropical shallow water coral reef ecosystem is largely unknown. Our research is designed to develop and test a simple procedure that managers can use to assess changes in coral reef ecosystems.
Our sampling work will be compatible with PMNM management practices and should not impact any cultural, historic, or natural resources. Water samples will be collected from the surface of the water column and will not impact any biological, physical, or cultural features of PMNM.

c. Is there a practicable alternative to conducting the activity within the Monument? If not, explain why your activities must be conducted in the Monument.
Our samples must be collected from PMNM waters in order to complete an assessment of the overall coral reef metabolism in PMNM.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?
One of the most fundmental processes within PMNM is the precipitation of calcium carbonate by reef building organisms. Calcium carbonate is precipitated by a variety of reef organisms and will dissolve via biotic and abiotic processes. Currently, the rate of precipitation is generally greater than the rate of dissolution throughout PMNM. However, as the open ocean carbonate chemistry changes the rate of calcification is anticipated to decrease and the rate of dissolution is anticipated to increase. The open ocean pH is anticipated to continue to decrease due to the rise of carbon dioxide in the atmosphere from the burning of fossil fuels, cement production, and deforestation. Lower open ocean pH is anticipated to make calcification more energetically expensive and dissolution more energetically favorable. Our research will develop a method that PMNM managers can use to monitor changes in reef metabolism from ocean acidification in a future high carbon dioxide world.

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.
One week of sampling is the minimum requirement to ensure the diel cycle captured from the sunrise and sunset samples accurately reflects the reef ecosystem metabolism being sampled.

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
Dr. Winn and Dr. Kahng have many years of experience researching carbonate chemistry. Dr. Winn has participated in research programs focusing on oceanic carbon chemistry for decades. Relevant experience includes participation as principle investigator on the Department of

Energy's Global Carbon Survey as part of the International World Ocean Circulation Experiment (WOCE) and the National Science Foundation's Joint Global Ocean Flux (JGOFS) program. These large scale research programs have included similar work on research cruises in virtually all of the world's oceans. Dr. Winn was a founding member of the Hawaii Ocean Time-Series program which is the longest running time series of water chemistry data in the Pacific Ocean. Dr. Kahng has been working in Hawaiiʻs coral reef environment for many years. He has worked on mesopelagic coral species and has extensive experience and expertise in coral reef biology and ecology. In addition, Dr. Kahng supervised a graduate student conduting a one year time-series carbon system measurement program in the near-shore waters at Kaiona Point, Oahu. The data collected provided some of the first data on carbon system dynamics on exposed coral reef environments in Hawaii.

g. Provide information demonstrating that you have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
Dr. Winn and Dr. Kahng are working closely with the Papahānaumokuākea Marine National Monument to plan the next research trip to the PMNM. The research described here is part of a funding request to the Pacific Islands Climate Change Cooperative.

h. Explain how your methods and procedures are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument cultural, natural and historic resources, qualities, and ecological integrity.
Our sample collection and analysis procedures have been developed over years of similar research throughout the global oceans. Our research will not involve the collection of any live animals or other materials from the monument and we will collect only shallow surface and subsurface seawater.

i. Has your vessel been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?
Not applicable.

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.
We cannot forsee any conditions that would make issuance of this permit inappropriate.

8. Procedures/Methods:
Our procedure involves the collection of water from the nearshore environment in the early afternoon and the late evening. If the researcher is stationed at an island, the sampler will wade into shallow water (approximately 1 meter in depth) and collect surface seawater in a clean bucket. The bucket will be carried to the beach to collect water samples. Alternatively if the researcher is operating from a small boat then a bucket will be lowered into the water over the side of the small boat to retreive water for sampling. Two or three replicate 250 mL subsamples will be collected from the bucket into Pyrex glass bottles. The extra water in the bucket once the sample bottles are full will be returned to the ocean. 100 microliters (about one drop) of a saturated mercuric chloride solution will be added to each bottle and the bottles will be sealed with apeizon grease for transport to our laboratory in Waimanalo, HI. The temperature and

salinity of the bucket sample will be measured with a simple hand-held conductivity and temperature meter called a YSI. The YSI is roughly the size of a large flashlight with a cable attached. The water remaining in the bucket will be returned to shallow water. This sampling method will be conducted in the morning and evening each day for the duration of our time in the PMNM.

The trip is not yet planned, but if possible it would be ideal to get nearshore samples from the shallow waters off all/ any land masses possible that are accessible by wading into the water to roughly 1 meter depth or easily accessible with a small two person kayak. The sample bottles and all chemicals would be kept on land contained in a storage box. When wading out or kayaking to the sampling location only the clean sampling bucket and the YSI (conductivity and temperature measurement tool) will be brought out into the water. The sample preservation technique is described in first paragraph of this section. The greater the duration of sampling at a single location, the greater the confidence in the analysis of the carbonate chemistry measurements. A more complex understanding of how currents and environmental conditions affect the magnitude of the diel signal is more likely with a longer sampling duration. The longest anticipated sampling duration on any one island is 30 days.

A suite of standard hydrographic measurements will be taken from the ship if it is equipped with the needed equipment. Standard hydrographic measurements typically include deploying a CTD (Conductivity, Temperature, and Depth measuring instrument) on a hydrowire attached to a winch onboard the ship. As the CTD is lowered through the water, continuous measurements are made by electronic sensors. No chemicals are released to the water column as the measurements are taken and recorded. The output from the CTD sensors is transmitted to a computer on the ship. Onboard the ship, the output voltages are converted to physical and chemical measurement values via a calibration algorithm. Most CTD assemblies will include a rosette around the electronic sensors that supports niskin water sampling bottles. The Niskin water sampling bottles can be closed at desired depths to collect water for further analysis in a laboratory setting. The water collected from the Niskin water sampling bottles follows the same sampling method as the surface water sampling described above. No waste of any kind will be introduced into monument waters.

A drifter drogue is proposed to be used in tandem with a bottom mounted acoustic doppler current profiler to measure the local currents at the sampling location. The current direction and speed indicate the origin of the water entering the sampling location which hints at the history of the water parcel. The residence time of the water parcel at the sampling location can also be determined by the current speed and direction. Residence time is a critical piece of information needed to interpret the carbonate chemistry measurements completely.

A drifter drogue consists of a surface buoy that is attached to a subsurface drogue with a thin rope. The surface buoy is designed to have minimal surface area above sea level relative to the surface area of the subsurface drogue. The subsurface drogue is generally built from a thin wire frame with a tarp material connecting the wires. The subsurface drogue is designed similar to a kite to catch the subsurface current. The greater subsurface surface area allows the primary force moving the drifter drogue to be the subsurface water current. The surface wind and current can

be a different direction and speed than the subsurface water current. In practice, a drifter drogue is deployed with a global positioning device (GPS) attached and the drifter drogue is followed from roughly 10 feet away for 30 to 60 minutes. The path is tracked on the GPS unit which is used to give the average subsurface water current speed and direction for the day. Each day this measurement will be taken once to determine the residence time of water at the sampling site and magnitude of the coral reef metabolic signal that should be measured that day.

An acoustic doppler current profiler (ADCP) is proposed to be set roughly 10 meters away from the shallow-water nearshore sampling location on the ocean bottom. The ADCP is proposed to be set in an area with a sand bottom at the start of sampling in the PMNM and will be retrieved at the conclusion of sampling in PMNM. An ADCP can measure small scale currents and how fast and what direction water is moving across the entire water column.

The carbonate chemistry group at HPU does not own an ADCP, but may have the ability to borrow an ADCP from another HPU department or organization outside HPU for the duration of the trip. Generally, an ADCP is roughly 0.25 meters x 0.25 meters x 0.25 meters. Generally, the ping frequency for ADCPs ranges from 300 to 1200 kHz. The ADCP unit will be mounted on a weighted frame and the frame will be placed on a section of sand bottom seafloor. The frame will be lowered down to the seafloor from a small boat and will be retrieved at the conclusion of the trip. Nothing will be left behind, all materials used with the ADCP will be removed from the seafloor at the conclusion of the trip.

Fluorescent tracer dye (fluorescein disodium salt) will also be used to analyze the directionality and speed of the surface seawater current. A small amount of dye (10 grams) is released onto the surface of the seawater which will fluoresce at 494 nm and 521 nm which can be recorded with a camera that picks up ultraviolet light. The MSDS for fluorescein disodium salt is included in this permit application along with the MSDS for sodium chloride (table salt that is regularly ingested) for comparison. A maximum of 300 grams total of fluorescein disodium salt will be used for the duration of the research trip.

NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding, as a customized application will be needed. For more information, contact the Monument office on the first page of this application.

9a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary):

Common name:
We will not collect any living specimens but we will be collecting seawater samples from the shallow near-shore environment at several collection points in PMNM.

Scientific name:
Not applicable.

& size of specimens:
Not applicable.

Collection location:
Not applicable.

☐ Whole Organism ☐ Partial Organism

9b. What will be done with the specimens after the project has ended?
Not applicable.

9c. Will the organisms be kept alive after collection? ☐ **Yes** ☐ **No**
Not applicable.

• General site/location for collections:
Shallow near-shore waters near island masses and backreef coral systems. Water column above the substrate from the surface to 1000 meters within roughly 15 kilometers of any emergent reef.

• Is it an open or closed system? ☒ Open ☐ Closed
All of our water samples will be drawn from the water column, preserved and returned to Waimanalo, Oahu for analysis. After measurement of the sample is complete the sample is poured into an open disposable container and the water is allowed to evaporate.

• Is there an outfall? ☐ Yes ☒ No
Not applicable.

• Will these organisms be housed with other organisms? If so, what are the other organisms?
Not applicable.

• Will organisms be released?
Not applicable.

10. If applicable, how will the collected samples or specimens be transported out of the Monument?
Samples will be returned to Waimanalo, Oahu by research vessel or airplane.

11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:
We anticipate exchanging a few water samples with other laboratories to ensure analytical accuracy and precision. Dr. Andrew Dickson's laboratory at Scripps Institution of Oceanography.
Contact Information:
Dr. Andrew Dickson
Marine Physical Laboratory
Scripps Instituion of Oceanography

University of California, San Diego
9500 Gilman Drive
[redacted]

In addition, we may share samples with Dr. Andreas Andersson, also at Scripps Institution of Oceanography.
Dr. Andreas Andersson
Scripps Institution of Oceanography
University of California, San Diego
[redacted]

12a. List all specialized gear and materials to be used in this activity:
A drifter drogue is proposed to be used in tandem with a bottom mounted acoustic doppler current profiler to measure the local currents at the sampling location. The current direction and speed indicate the origin of the water entering the sampling location which hints at the history of the water parcel. The residence time of the water parcel at the sampling location can also be determined by the current speed and direction. Residence time is a critical piece of information needed to interpret the carbonate chemistry completely.

A drifter drogue consists of a surface buoy that is attached to a subsurface drogue with a thin rope. The surface buoy is designed to have minimal surface area above sea level relative to the surface area of the subsurface drogue. The greater subsurface surface area allows the primary force moving the drifter drogue to be the subsurface water current. The surface wind and current can be a different direction and speed than the subsurface water current. In practice, a drifter drogue is deployed with a global positioning device (GPS) attached and the drifter drogue is followed from roughly 10 feet away for 30 to 60 minutes. The path is tracked on the GPS unit which is used to give the average subsurface water current speed and direction for the day. Each day this measurement will be taken once to determine the residence time of water at the sampling site and magnitude of the coral reef metabolic signal that should be measured that day.

An acoustic doppler current profiler (ADCP) is proposed to be set roughly 10 meters away from the shallow-water nearshore sampling location on the ocean bottom. The ADCP is proposed to be set in an area with a sand bottom at the start of sampling in the PMNM and will be retrieved at the conclusion of sampling in PMNM. An ADCP can measure small scale currents and how fast and what direction water is moving across the entire water column.

In tandem or in place of the drifter drogue and ADCP unit fluorescent dye tracer (fluorescein disodium salt) will be used to map the directionality and speed of the surface current.

The ship's CTD, rosette, winch, and hydrowire will be utilized to measure and record continuous CTD data as well as collect water samples at depth.

The temperature and salinity of the bucket sample will be measured with a simple hand-held conductivity and temperature meter called a YSI. The YSI is roughly the size of a large flashlight with a cable attached.

To ensure consistent sampling locations temporary marker buoys will be set in the shallow water sampling locations on a sand bottom.

12b. List all Hazardous Materials you propose to take to and use within the Monument:
Small amounts of Mercuric Chloride. This chemical will be used for sample preservation only and will not be released into monument waters. We add this chemical to our water samples into order to preserve them for analysis in shore-based laboratories. This chemical is also used sparingly, the amount used for 200 collection bottle samples is 0.02 Liters.

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:
An acoustic doppler current profiler (ADCP) is proposed to be set roughly 10 meters away from the sampling location on the ocean bottom. The ADCP is proposed to be set in an area with a sand bottom at the start of sampling in the PMNM and will be retrieved at the conclusion of sampling in PMNM. An ADCP can measure small scale currents and how fast and what direction water is moving across the entire water column. An ADCP measures water currents with sound waves using the principle of the Doppler effect. An ADCP works by transmitting a 'ping' of sound at a constant frequency into the water column. The sound waves travel away from the ADCP and richochet off particles suspended in the water and are reflected back to the ADCP. The Doppler effect causes the sound waves traveling back to the ADCP to be at a slightly lowered frequency.
Particles moving toward the instrument send back a slightly higher frequency than particles moving away from the ADCP. The ADCP can calculate how fast each particle is moving and in what direction.
The pings emit are so highly pitched humans cannot hear them and it is believed they are also outside of the audible range for most marine mammals like dolphins. The ADCP uses piezoelectric oscillartors to transmit and receive sound signals. There are no moving parts to an ADCP. In the surface ocean the temperature and salinity of the water column is relatively constant which makes the ADCP one of the more effective measurements of current direction and speed.

14. Provide a time line for sample analysis, data analysis, write-up and publication of information:
Complete analysis and interpretation of carbonate chemistry measurement of all samples will require approximately six months following the completion of the sampling period. Our data will be compiled in a data report that will be submitted to the NOAA PMNM program and PICCC as required.

15. List all Applicants' publications directly related to the proposed project:

Lantz CA, Atkinson MJ, Winn CD, Kahng SE (2013) Dissolved inorganic carbon and total alkalinity of a Hawaiian fringing reef: chemical techniques for monitoring the effects of ocean acidification on coral reefs. Coral Reefs 10:1-11

Thompson RW, Dickson AG, Kahng SE, Winn CD (2014) Nearshore Carbonate Dissolution in the Hawaiian Archipelago. Aquatic Geochemistry

Please see the attached C.V. for a full list of credentials.

With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct. I agree that the Co-Trustees may post this application in its entirety on the Internet. I understand that the Co-Trustees will consider deleting all information that I have identified as "confidential" prior to posting the application.

_____

Signature Date

SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE BELOW:

NOAA/Inouye Regional Center
NOS/ONMS/PMNM/Attn: Permit Coordinator
1845 Wasp Blvd, Building 176
Honolulu, HI 96818
FAX: (808) 455-3093

DID YOU INCLUDE THESE?

☒ Applicant CV/Resume/Biography
☒ Intended field Principal Investigator CV/Resume/Biography
☒ Electronic and Hard Copy of Application with Signature
☐ Statement of information you wish to be kept confidential
☒ Material Safety Data Sheets for Hazardous Materials