



MINISTRY OF TRANSPORT

Te Mana Tumotu o Te Kuki Airani

P O Box 61, Rarotonga, Cook Islands.

Tel: (682) 28-810, Fax: (682) 28-816, E-mail: tony.wearing@cookislands.gov.ck

Reference No: RPAS-2026-054

18 May 2026

School of Earth and Ocean Sciences
A419 Bob Wright Center
University of Victoria, Victoria, BC
CANADA

For the attention of: Mr. Blake Dyer

SUBJECT: APPROVAL TO OPERATE DRONE WITHIN ATIU, MANGAIA, MAUKE & MITIARO AIRPORTS' RPAS EXCLUSION ZONES.

Kia Orana Blake,

Thank you for your application to operate your drone within Atiu, Mangaia, Mauke & Mitiaro Airports' RPAS Exclusion Zones for the sole purpose of capturing aerial content for academic & non-commercial scientific research. Your application has been approved for the following drones:

- **DJI PHANTOM 4 PRO SN: 11W6J1400SAM2F**

Approval is hereby subject to the following conditions:

1. Operations are to be conducted in compliance with Cook Island's Civil Aviation Rules (CICAR) Part 101.
2. All drone operations are to be coordinated and cleared by the Atiu, Mangaia, Mauke & Mitiaro Air Rarotonga Agents. (See respective contact details below).
3. All drone operations are not to be undertaken within 30 minutes of an aircraft's arrival or departure.
4. All landowners or residents must agree prior to flying over their properties.
5. No flights are permitted over any public gatherings.
6. Flights are to be limited solely for the above stated purpose.
7. Approval for the application activity within the RPAS Exclusion zone is from:
 - **Atiu – 25 May 2026 through to 29 May 2026**
 - **Mangaia – 1 June 2026 through to 4 June 2026**
 - **Mauke – 5 June 2026 through to 8 June 2026**
 - **Mitiaro – 9 June 2026 through to 12 June 2026**

Kia Manuia,

Tony Wearing
Director of Civil Aviation

Cc: Mr. Taoro Brown – Atiu Executive Officer, Tel +682 33269 Mobile +682 55899
Mr. Mia Teaurima – Mangaia Executive Officer, Tel +682 34289 Mobile +682 88961
Ms. Nooroa – Mauke Executive Officer, Tel +682 35081 Mobile +682 87454
Ms. Anna Roi – Mitiaro Executive Officer, Tel +682 36108 Mobile +682 55268



Blake Dyer

Associate Professor — School of Earth and Ocean
Sciences

University of Victoria

PO Box 1700 STN CSC
Victoria, British Columbia V8W 2Y2 Canada
1.250.883.5418 — blakedyer@uvic.ca
<https://blakedyer.github.io/>

May 1, 2026

Director of Civil Aviation
Civil Aviation Authority of the Cook Islands
Ministry of Transport
Rarotonga, Cook Islands

Dear Director,

I am writing to request Civil Aviation Authority approval to operate a small remotely piloted aircraft system (RPAS) in support of academic field research by Columbia University, the University of Florida, and the University of Victoria in the southern Cook Islands. The attached package includes the completed RPAS application, supplemental site table, detailed island maps, pilot certificate, Cook Islands research proposal and approval permit, and supporting research-application materials.

The requested flights are for academic research with no commercial value. The RPAS will be used for low-altitude photographic scans of coastal rock outcrops to supplement ground-based geologic survey work. The photographs will support photogrammetry / structure-from-motion models, and differential GPS will georeference the survey data. Together, these data provide precise location measurements for geologic features, including the position and orientation of fossil corals, used to reconstruct the sea-level history of the surveyed sites.

This application requests operations on Atiu (25–29 May 2026), Mangaia (1–4 June 2026), Mauke (5–8 June 2026), and Mitiaro (9–12 June 2026). The site table and maps show the requested operating areas day by day. Approval for operations within 4 km of an airfield are requested for a subset of the days on Atiu (27–28 May 2026), Mangaia (3 June 2026), Mauke (6–7 June 2026), and Mitiaro (10–11 June 2026). For this subset of days we request geofencing authorization to fly closer to the airfields. To the best of our knowledge, we requested days with no commercial flights to the airfields, but we are aware that other traffic may be present. We are flexible and willing to adjust flight windows, launch points, or any other request or conditions that CAACI considers appropriate to ensure safe operations.

The flights are low-risk and tightly constrained. The RPAS will remain within visual line of sight of the operator, with an assistant to act as a second observer. Flights will occur during daylight only, normally below 100 feet above ground level (AGL) and always below 120 m / 400 feet AGL. Operations will avoid people and populated areas, will not be conducted in adverse weather, and will stop if wildlife disturbance is a concern. The pilot will remain reachable by mobile phone at least 30 minutes before flight and during operations, and the RPAS will land before moving to a new flight area. We will obtain a local cellular number when we arrive in Rarotonga on 24 May 2026, and we will provide that number to CAACI before operations begin.

Our research group has extensive experience using small drones for this same type of geologic field work, including carbonate-island and coastal geologic fieldwork in The Bahamas, Turks and Caicos, and Hawaii. Additionally, we have flown extensively in remote mountain settings in British Columbia and the western US. Altogether, we have likely logged near 100 hours of flight time since 2016 without incident. The requested Cook Islands operations follow the same pattern as these past flights: low flight, visual-line-of-sight photography in remote settings to document specific outcrops.

Thank you for your consideration.

Sincerely,
Blake Dyer

Table of Contents

1. Cover letter
2. Completed RPAS application form
3. Supplemental site table
4. Annotated maps
5. Maps showing requested operating areas and days within-4-km of airfields.
6. Pilot certificate
7. Research permit
8. Research application
9. Response to application questions

Requested islands: ATIU, MANGAIA, MAUKE, MITIARO

Research permit reference: Cook Islands National Research Committee permit 28-25



MINISTRY OF TRANSPORT

Te Mana Tumotu o Te Kuki Airani

PO BOX 61, Rarotonga, Cook Islands

Tel: (682) 28-810, Fax: (682) 28-816, E-mail: teanau.rani@cookislands.gov.ck

CIVIL AVIATION AUTHORITY OF THE COOK ISLANDS

Instructions: Use capital letters when filling out form and ensure all sections marked with red asterisk (*) are completed.

APPLICATION TO OPERATE RPAS (DRONE)

RPAS (Drone) Pilot - Applicant Information

Full Name*: DYER BLAKE **Date*:** MAY 1 2026
Last First

Address*: A419 BOB WRIGHT CENTER, UNIVERSITY OF VICTORIA, VICTORIA, BC, CANADA

Company Name*: SCHOOL OF EARTH AND OCEAN SCIENCES

Phone/Mobile*: +1-250-883-5418 **Email*:** blakedyer@uvic.ca

Passport Number*: 572227749 **Nationality*:** USA
* Attach e-copy of bio page with application

Pilot Training Certificate or License: PC2115371036 **Certificate of Insurance:** NO ☒ YES ☐
* Attach e-copy with application if applicable

Flight Details

	Name of Island*	Flight Start Date*	Flight End Date*	Takeoff / Landing Location	Flight Area Description (Briefly describe surroundings)	Maximum Flight Altitude In Meters / Feet* (Max. 120m/400ft AGL)
1)	ATIU	25 MAY 2026	29 MAY 2026	SEE ATTACHED MAP 1	COASTAL ROCKS	30 m / 100 ft AGL
2)	MANGAIA	1 JUNE 2026	4 JUNE 2026	SEE ATTACHED MAP 2	COASTAL ROCKS	30 m / 100 ft AGL
3)	MAUKE	5 JUNE 2026	8 JUNE 2026	SEE ATTACHED MAP 3	COASTAL ROCKS	30 m / 100 ft AGL
4	MITIARO	9 JUNE 2026	12 JUNE 2026	SEE ATTACHED MAP 4	COASTAL ROCKS	30 m / 100 ft AGL

Flight Category*: Professional / Commercial ☒ Recreational ☐

Flight Purpose*: ACADEMIC, NON-COMMERCIAL SCIENTIFIC RESEARCH. LOW-ALTITUDE AND LINE OF SIGHT PHOTOGRAPHIC SCANS OF COASTAL ROCK OUTCROPS TO SUPPORT GROUND GEOLOGIC SURVEY, PHOTOGRAMMETRY / STRUCTURE-FROM-MOTION MODELS, AND DIFFERENTIAL GPS GEOREFERENCING. SEE ATTACHED LETTER, SUPPLEMENTAL SITE TABLE, AND MAPS.

Flight to be operated within 4kms of an airfield*: NO ☐ YES ☒
(ONLY SOME, SEE ATTACHED MAP 5)

RPAS (Drone) Details

Maximum takeoff Mass

	Drone Brand/Model*	Drone Serial Number*	Camera Serial Number	Remote/Flight Controller Serial Number	Drone MTOM (kg) including camera equipment*	RPAS (Drone) Registration Number
1)	DJI PHANTOM 4 PRO	11W6J1400SAM2F			1575 g	
2)						
3)						
4)						
5)						

Request for removal of Geofencing*: NO ☐ YES ☒**IMPORTANT RULES TO FOLLOW ALONG WITH RPAS REGULATION**

The following flight rules do not supersede any rules found in the official CICARs Part 101 and 102 document.

1. Only persons that have been approved on the request can operate the RPAS (Drone).
2. The RPAS will not be flown at a height greater than 400 feet AGL (above ground level).
3. The RPAS will not be operated within 4km of an airport unless approved.
4. The RPAS is flown within the visual line of sight (VLOS) of the operator (at all times).
5. The RPAS is only operated during daylight hours in compliance with CICARs Part 101 and 102.
6. The RPAS will not be operated over people or populated areas.
7. The RPAS will not be operated in adverse weather conditions.
8. Pilot License and International / National Insurance Certificate may be required.
9. The RPAS pilot must remain reachable by mobile phone at least 30 min before flight (and at all times).
10. The RPAS will be required to land first, and then move to the new location if multiple flying areas are used.
11. All National and Data Privacy legislation must be observed.

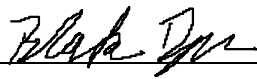
CICAR Part 101 can be downloaded free from the following web site www.transport.gov.ck

Applicant Declaration*

I, BLAKE DYER, hereby declare that all information in this application is true, complete, and accurate. I acknowledge that I have read, understood, and agree to abide by all the rules outlined above.

(full Name)

By signing below, I confirm my compliance and understanding.

Applicant (Pilot) Signature*:  Date*: MAY 01 2026

Internal Use Only – CIVIL AVIATION AUTHORITY COOK ISLANDS

Review Date	
Special considerations, instructions and comments	
DCA CAACI Decision	APPROVED ☐ DECLINED ☐
CAACI personnel Name and Signature	

Supplemental Site Table

Island	Date	Within 4 km airfield	Map ref.
Atiu	25 May 2026	No	1
Atiu	26 May 2026	No	1
Atiu	27 May 2026	Yes	1, 5
Atiu	28 May 2026	Yes	1, 5
Atiu	29 May 2026 AM	No	1
Mangaia	1 Jun 2026	No	2
Mangaia	2 Jun 2026	No	2
Mangaia	3 Jun 2026	Yes	2, 5
Mangaia	4 Jun 2026	No	2
Mauke	5 Jun 2026	No	3
Mauke	6 Jun 2026	Yes	3, 5
Mauke	7 Jun 2026	Yes	3, 5
Mauke	8 Jun 2026	No	3
Mitiaro	9 Jun 2026	No	4
Mitiaro	10 Jun 2026	Yes	4, 5
Mitiaro	11 Jun 2026	Yes	4, 5
Mitiaro	12 Jun 2026	No	4

Annotated Maps

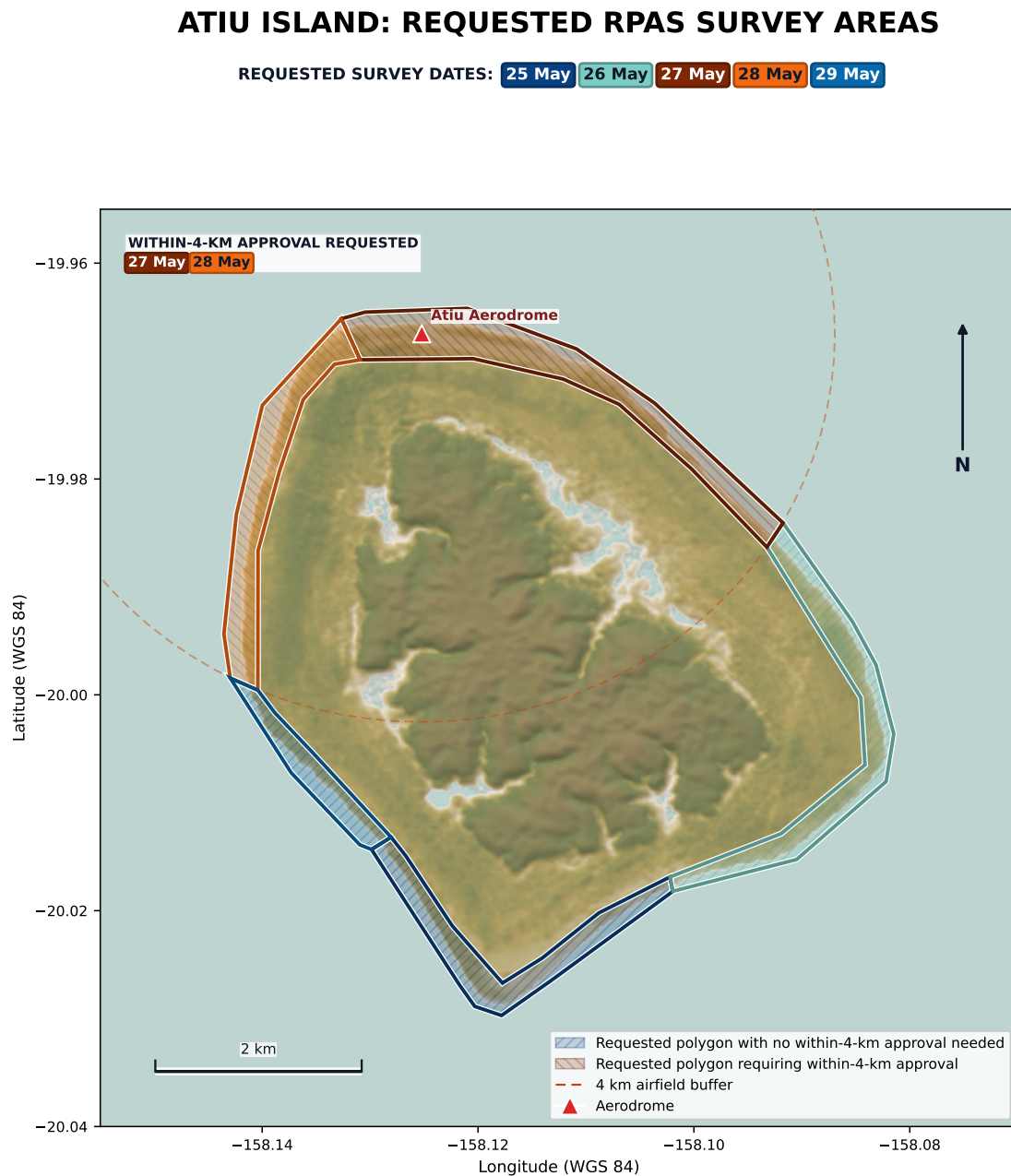


Figure 1: Atiu requested RPAS operating areas. Date chips at the top match the polygon colors on the map; warm hatched polygons mark requested sites within 4 km of the aerodrome, and cool hatched polygons mark requested sites outside that buffer.

MANGAIA ISLAND: REQUESTED RPAS SURVEY AREAS

REQUESTED SURVEY DATES: 1 Jun 2 Jun 3 Jun 4 Jun

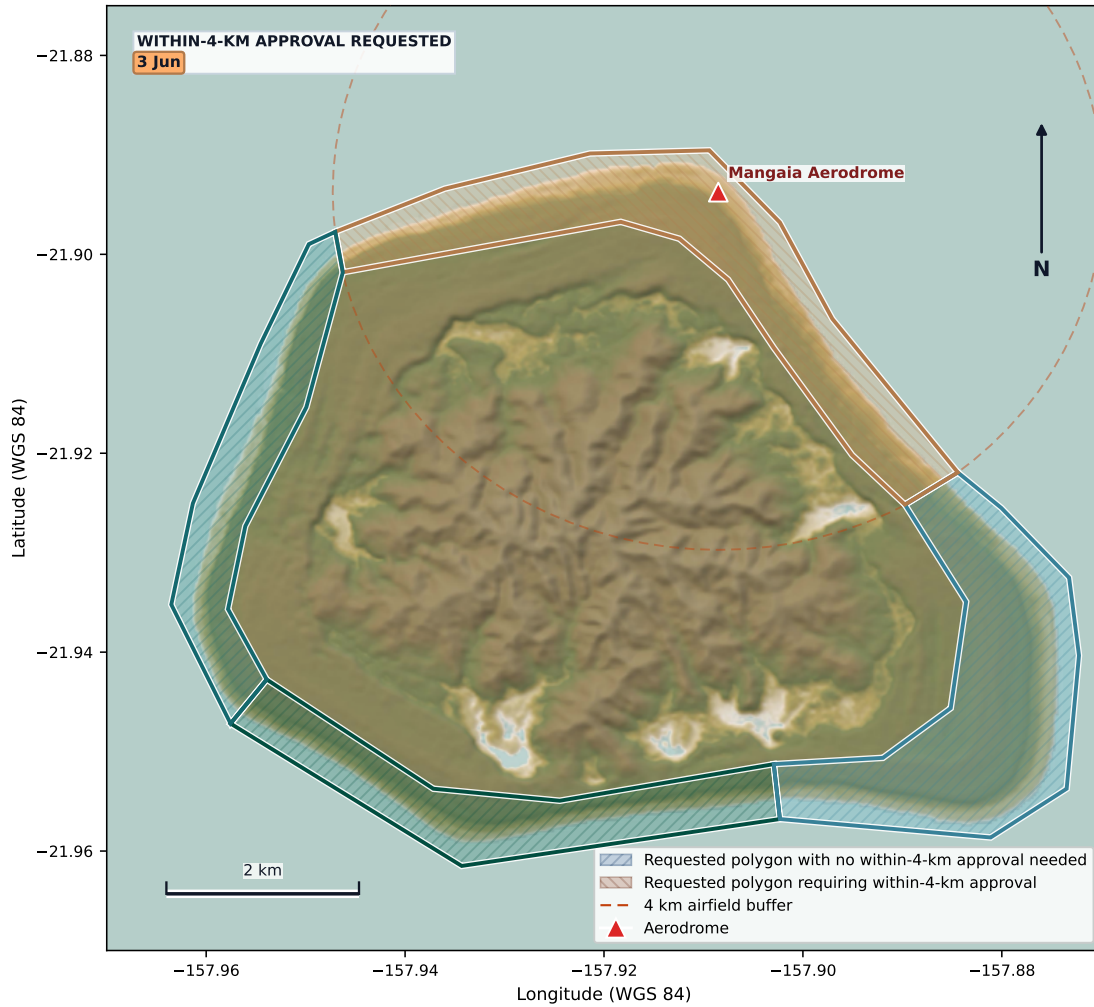


Figure 2: Mangaia requested RPAS operating areas. Date chips at the top match the polygon colors on the map; warm hatched polygons mark requested sites within 4 km of the aerodrome, and cool hatched polygons mark requested sites outside that buffer.

MAUKE ISLAND: REQUESTED RPAS SURVEY AREAS

REQUESTED SURVEY DATES: 5 Jun 6 Jun 7 Jun 8 Jun

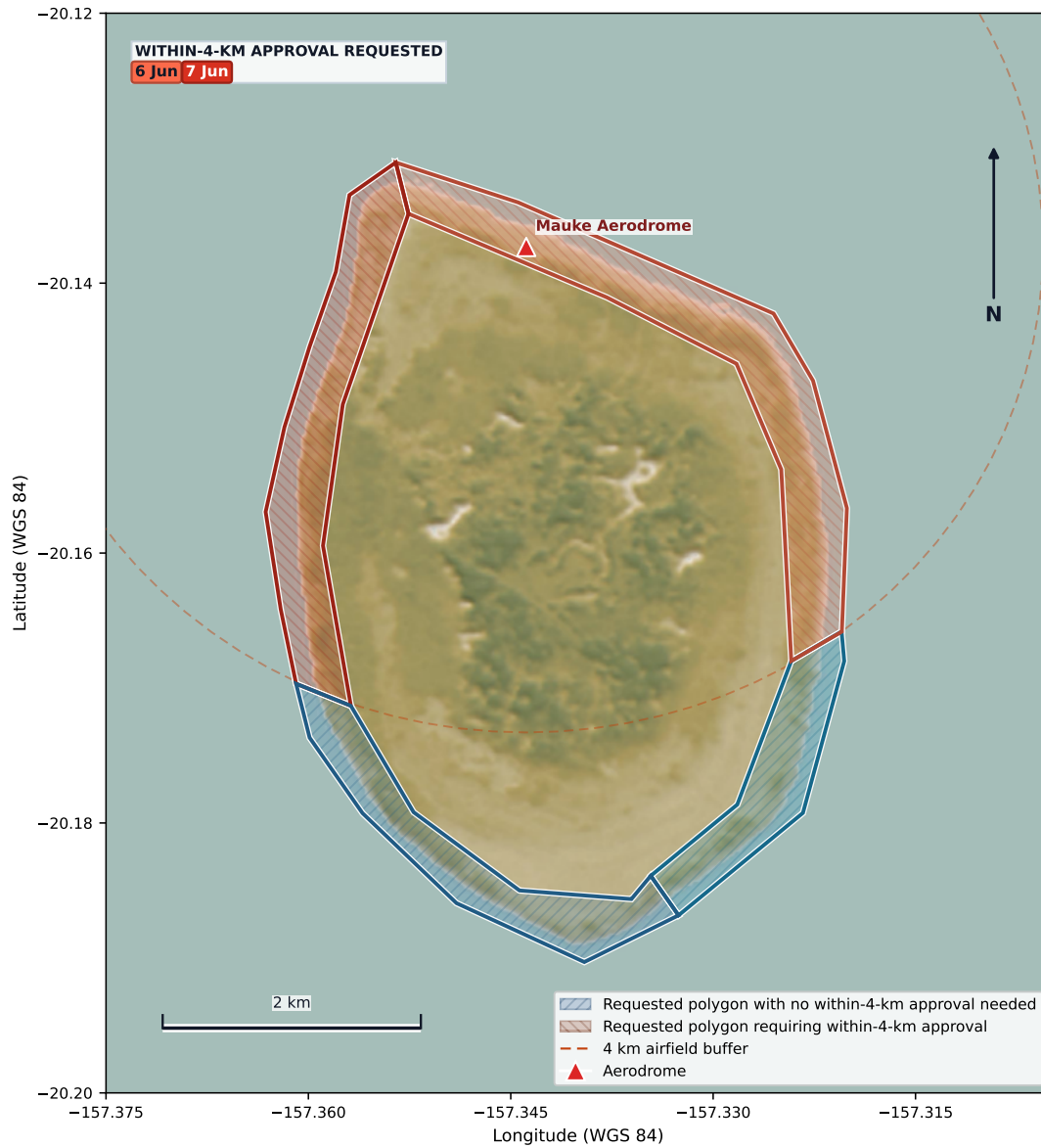


Figure 3: Mauke requested RPAS operating areas. Date chips at the top match the polygon colors on the map; warm hatched polygons mark requested sites within 4 km of the aerodrome, and cool hatched polygons mark requested sites outside that buffer.

MITIARO ISLAND: REQUESTED RPAS SURVEY AREAS

REQUESTED SURVEY DATES: 9 Jun 10 Jun 11 Jun 12 Jun

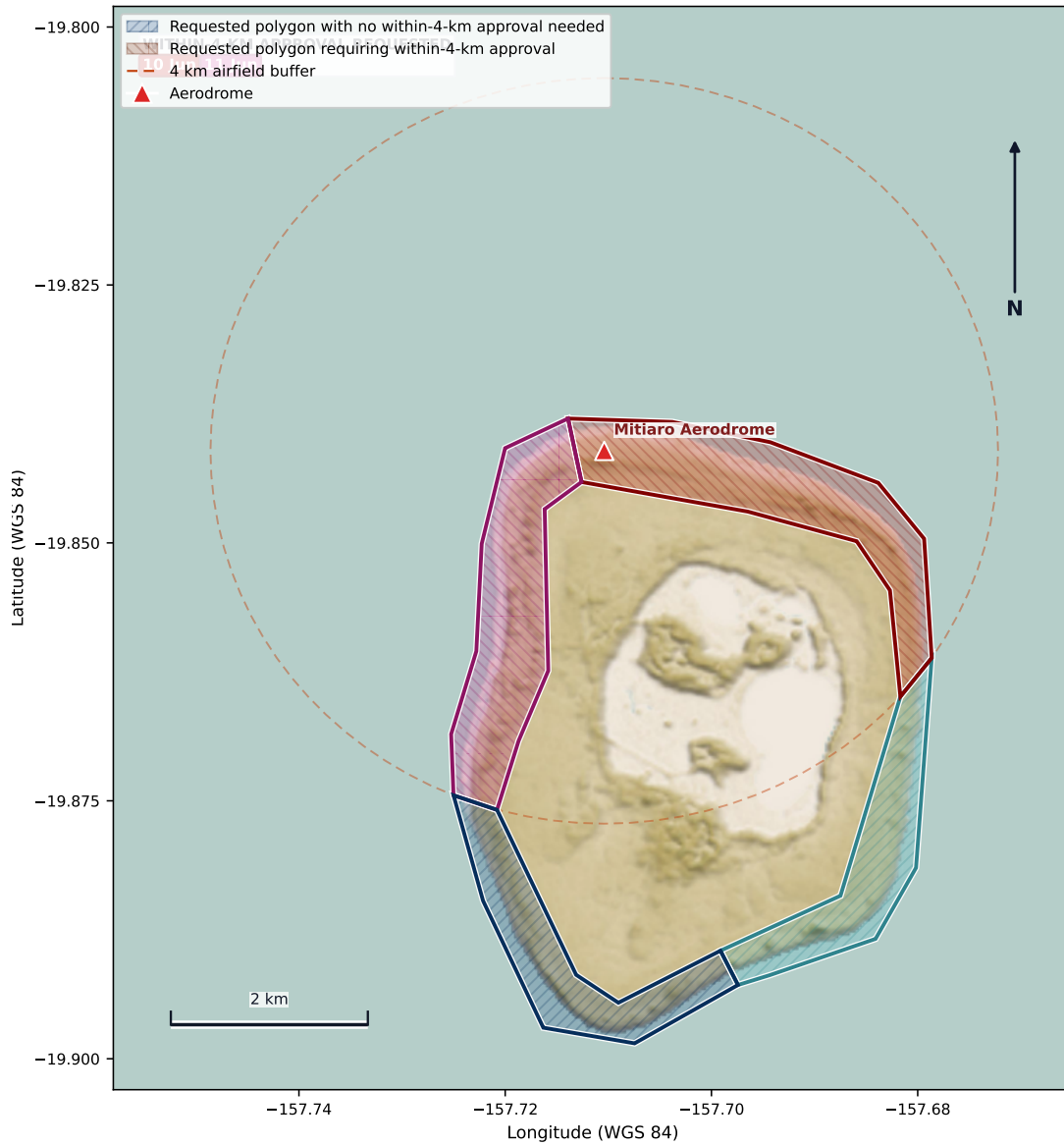


Figure 4: Mitiaro requested RPAS operating areas. Date chips at the top match the polygon colors on the map; warm hatched polygons mark requested sites within 4 km of the aerodrome, and cool hatched polygons mark requested sites outside that buffer.

ONLY THESE POLYGONS REQUIRE WITHIN-4-KM APPROVAL

ONLY DATES REQUIRING WITHIN-4-KM APPROVAL: 27 May 28 May 3 Jun 6 Jun 7 Jun 10 Jun 11 Jun

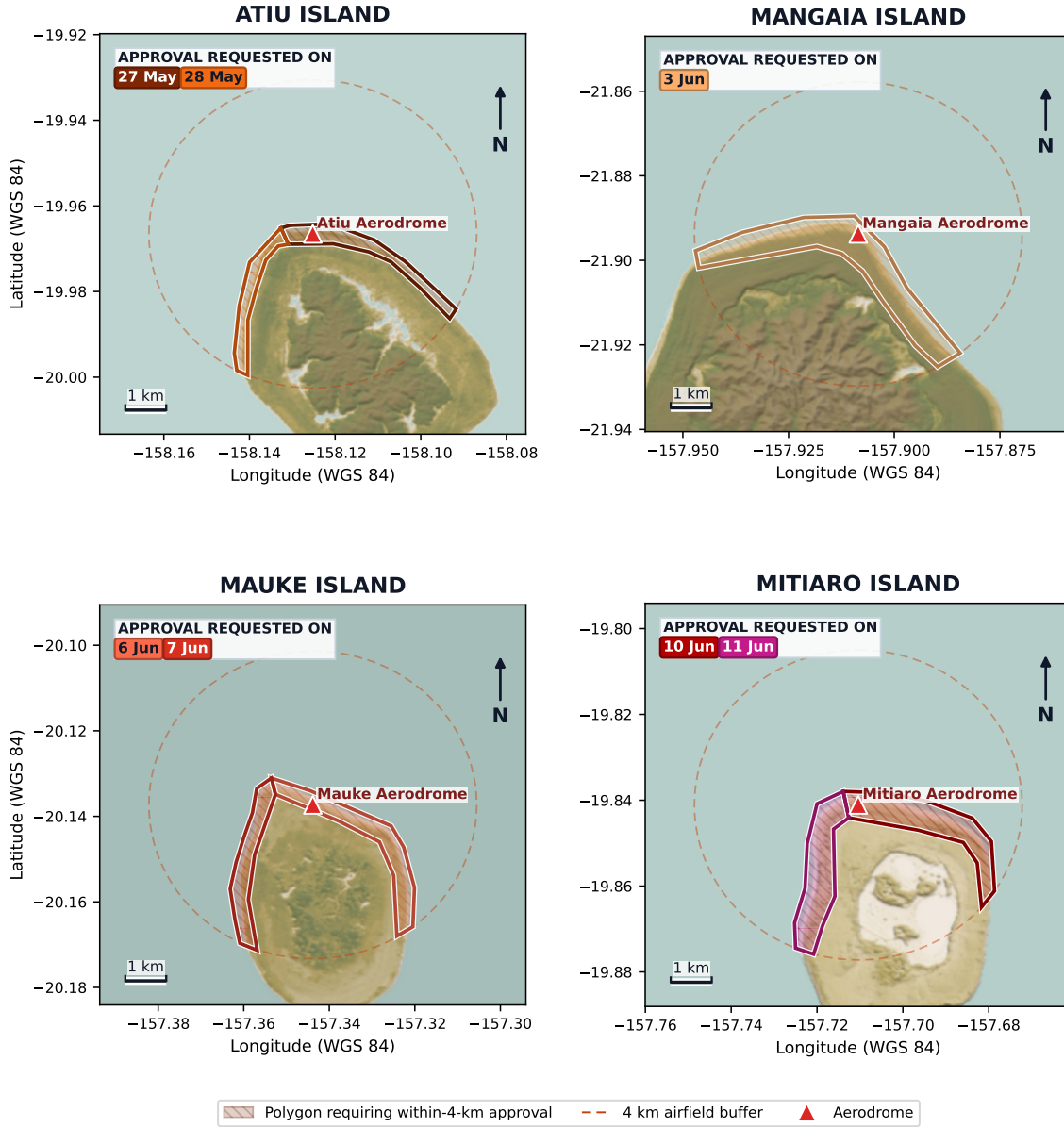


Figure 5: Island-by-island clarification of the requested operations within 4 km of aerodromes. Date chips at the top match the polygon colors in the panels, and the warm hatched polygons shown here are the only locations in this draft for which within-4-km approval and DJI geofencing authorization are requested.

Pilot certificate

Small Remotely Piloted Aircraft (VLOS)

Basic operations

PC2115371036

Issued on June 2, 2021 to:

Blake Dyer

412 Lampson St

Victoria, BC V9A 5Z1

TC2115307994

CANADIAN AVIATION DOCUMENT



Transport
Canada

Transports
Canada

Canada

Certificat de pilote

Petit aéronef télépiloté (VLOS)

Opérations de base

PC2115371036

Délivré le 2 juin 2021 à :

Blake Dyer

412 Lampson St

Victoria, BC V9A 5Z1

TC2115307994

DOCUMENT D'AVIATION CANADIEN



Transport
Canada

Transports
Canada

Canada

PERMIT TO UNDERTAKE

Research in the Cook Islands

This is to certify that: **Dr Jacqueline Austermann**

Has permission from the Cook Islands National Research Committee to conduct research in the Cook Islands from: **1 May 2026 – 31 August 2026.**

On the islands of: **Atiu, Mangaia, Mauke, Mitiaro, Rarotonga**

The topic of research is: **"Reconstructing past sea level variability in the Cook Islands."**

The Cook Islands Researcher is: **Mr Wayne King**

The following special conditions apply to this research:

- **The researcher complies with the Cook Islands Immigration, SBMA, OPM (Marae Moana), Ministry of Transport, Ministry of Marine Resources and National Environment Services requirements.**
- **The researcher provides a preliminary report to the Office of the Prime Minister at the earliest**
- **The researcher provides three (3) hard copies + one (1) e-copy of the final output generated from this research to the Office of the Prime Minister by December 2026.**

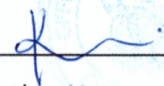
Permit Issued on: **12 March 2026**

Issued by: **Karopaerangi Ngatoko**

CHAIRPERSON

Receipt Number:

Reference Number: **28-25**

Signed:  _____

For enquiries concerning this permit, please quote the Name of the Researcher and the Reference Number to the Secretariat of the National Research Committee at the Office of the Prime Minister, Rarotonga, Cook Islands. Phone (682) 25 494, or Email: research.secretariat@cookislands.gov.ck Website: www.pmooffice.gov.ck

Office use only

Application number:

Date application received:

Research application Form (RAF-08)

Read the following:

- Ensure you have ethics approval from the Cook Islands Ethics Committee if your research is empirical
- Read the *Guiding Principles for Research Conducted in the Cook Islands*
- Use Arial 11 and single space
- Do NOT go over the recommended word count
- Grammar and spell check your application
- Question prompts are there to help you. Delete prompts and start typing your responses
- Answer all questions.

1. Contact details	
Principal investigator	
Title	Dr
Name	Jacqueline Austermann
Host Institution	Columbia University
Position in host institution	Associate Professor
Department	Department of Earth and Environmental Sciences
Address	61 Route 9W Palisades, NY 10964-8000 USA
Email	ja3170@columbia.edu
Home address	44 Morningside Dr., Apt 4, New York, NY 10025, USA
Attach CV (two page max) and photo identification (current passport or driver license)	Yes
Other named investigator	
Title	Dr.
Name	William D'Andrea
Host Institution	Lamont-Doherty Earth Observatory
Position in host institution	Lamont Associate Research Professor
Department	Biology & Paleo Environment
Address	61 Route 9W Palisades, NY 10964-8000 USA
Email	dandrea@ldeo.columbia.edu
Home address	26 Dickinson Ave, Nyack, NY 10960, USA
Attach CV (two page max) and photo identification (current passport or driver license)	Yes
Cook Islands investigator	
Title	N/A
First Name(s)	N/A
Contact details	N/A
Host institution	N/A
Address	N/A
Telephone number	N/A
Email	N/A

Attach CV (two page max) and photo identification (current passport or driver	No
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license)	
2. Research funding	
Research funder	National Science Foundation (NSF)
Total fund	NZD 77,706 (includes the itemized budget below and international flights to Cook Islands)
Total funding to be used in the Cook Islands. Itemise budget lines only (200 words)	The following is the itemised budget per person. We anticipate a total group size of six persons: Lodging: NZD 170/night × 21 nights = NZD 3,570 Meals: NZD 80/day × 21 days = NZD 1,680 Ground Transportation: NZD 260 Rental Car Share: NZD 865 Additional Local Flight: NZD 350 Total funding to be used in the Cook Islands: NZD40,350
3. Project details	
Title of research project (max 50 words) Reconstructing past sea level variability in the Cook Islands	
Proposed dates for research: May 1- August 31 2026	
Sector Tick ☒ the primary sector/s to which the research applies ☐ Agriculture ☐ Culture ☐ Education ☒ Environment ☐ Health ☐ Marine ☐ Natural Heritage ☐ Social Development ☐ Spirituality ☐ Tourism ☐ Infrastructure ☐ Other - Please specify	
Location	

Tick all relevant boxes	
☐	Aitutaki
X	Atiu
X	Mangaia
☐	Manihiki
☐	Manuae
X	Mauke
X	Mitiaro
☐	Nassau
☐	Palmerton
☐	Penrhyn
☐	Pukapuka
☐	Rakahanga
X	Rarotonga
☐	Suvarrow
☐	Territorial waters
Aims and objectives of the project We aim to reconstruct how high sea level was, and hence how small ice sheets were, during the Last Interglacial time period (around 125,000 years ago). Our main objective is to conduct fieldwork and to perform high-precision dating analyses (e.g., uranium-thorium dating) that will significantly expand the number and quality of available Last interglacial sea level reconstructions in the Pacific from Pleistocene reef complexes. With this field and lab data, we will test scientific models of sea level and ice sheet change. Overall, our research will help reduce uncertainty in past sea level estimates, which can improve predictions about how ice sheets will respond to future warming.	
Alignment to Cook Islands values and/or goals outlined in the <i>National Sustainable Development Plan 2016–2020</i>.¹ (200 words)	

¹http://www.mfem.gov.ck/images/documents/CEO_docs/Other%20Documents/National-Sustainable-Development-Plan_2016-2020.pdf

Our research on past sea-level change during the Last Interglacial period directly supports the Cook Islands' National Sustainable Development Agenda 2020+ and reflects the shared values of *Kia Orana*. By studying ancient reefs and reconstructing former sea levels, we advance *Kite Pakari*, the pursuit of knowledge, through scientific innovation grounded in respect for traditional environmental knowledge and island heritage.

Our work contributes to *Ora*, promoting the long-term resilience and wellbeing of Cook Islands communities facing rising seas and ensuring their continued connection to the land and ocean. Guided by the principles of *Akakoromaki* (collaboration) and *Akatapu* (respect), we prioritize fairness, reciprocity, and shared learning. We are already in conversation with Mr. Wayne King, Director of Climate Change Cook Islands, who is helping us build collaborations with other interested local parties.

Approaching our work with *Tu 'Aka'aka* (humility) and *'Au* (peace), we recognize the privilege of conducting research in this unique environment. By refining future sea-level projections, our research empowers *Noa*, the freedom and dignity of communities to plan, adapt, and thrive amid change. Ultimately, our commitment to *Aro'a* and *Meitaki* reflects gratitude to the people of the Cook Islands and our shared responsibility as *Tiaki* (guardians) of Earth's natural heritage.

Research design and methods (500-800 words)

Our methodology combines field documentation, precise surveying, laboratory analyses, and modelling experiments to generate robust Last Interglacial sea-level reconstructions from the South Pacific, a critical region for fingerprinting ice sheet melt.

- In the field, we will non-destructively survey fossilized reef outcrops using hand-held and drone photography, while also conducting detailed descriptions of sedimentary features. Approximately 50 small carbonate rock samples, including fossilized corals preserved in growth position, will be collected for U-Th dating. High-precision elevation measurements will be obtained using differential GPS (cm-scale vertical precision) to georeference photogrammetric models and integrate them with other surveyed outcrops. Additionally, tide gauges will be deployed in shallow water bays for several days to measure the absolute elevation of mean sea level.
- Digital reconstruction: Using photogrammetry we will create 3D digital models of each outcrop.
- Sea-level reconstruction: The elevation of each outcrop will be referenced to a map of local mean sea level that we will generate using the tide gauge measurements and modern tidal notches. When all of the elevation uncertainties are fully propagated, the expected precision of measured elevation relative to local mean sea level is likely between ± 8 and ± 30 cm.
- Laboratory analyses will be conducted in Prof. Oana Dumitru's laboratory at the University of Florida and Prof. Steve Goldstein's laboratory at Lamont-Doherty Earth Observatory. Each sample will first be assessed for preservation and screened for diagenetic alteration to ensure closed-system behavior. U and Th fractions will then be separated, and isotopic compositions measured on a Multi-Collector ICP-MS to determine robust ages of corals.
- Integration with models: Our U-Th chronologies will be integrated with sea level models, to provide the first high-precision Last Interglacial sea-level record from the South Pacific.

Our target sites for field mapping and sample collection will include locations along the coastlines of Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke. Locations characterized by rocky headlands will be prioritized during our field campaign. We will also conduct

reconnaissance survey work, expected to be more limited, on the interior southern side of the islands.

Impact of research (200-400 words)

Our research focuses on reconstructing past sea levels in the Pacific region, with a particular emphasis on the Last Interglacial period, a time when global temperatures and atmospheric CO₂ levels were comparable to those predicted for the near future. By examining ancient reef formations in the Cook Islands, we aim to gain insights into how high sea levels rose during this period and what that reveals about the future stability of ice sheets and low-lying coastal regions.

This study has strong local relevance. The Cook Islands, like many Pacific nations, face increasing threats from sea-level rise, which endangers not only infrastructure and freshwater supplies but also livelihoods and cultural heritage. By improving our understanding of historical sea-level changes, we contribute essential data to refine future projections. These projections are crucial for effective long-term planning, climate resilience strategies, disaster risk reduction, and sustainable land use.

In alignment with the Cook Islands' National Sustainable Development Agenda 2020+, our research supports the development of science-based, forward-looking solutions. Although our work investigates the geological past, it ultimately serves to inform and strengthen the nation's capacity to respond to future climate-related challenges.

Beyond local benefits, the outcomes of this project hold significant value for the global scientific community. Our data will contribute to ongoing efforts by climate scientists, glaciologists, geophysicists, and geomorphologists to better understand the interactions between sea level, ice sheet behavior, Earth's climate system, and geophysical processes. All observations and findings will be rigorously documented and made accessible for future integration into global datasets on Last Interglacial sea level.

Our field surveys will produce high-resolution elevation data and georeferenced 3D models of key sites, which will be published and made available to both the scientific community and the people of the Cook Islands. Research outcomes will be shared through peer-reviewed journals, open-access platforms, and presentations at international conferences to ensure broad dissemination.

Additionally, this project will shed light on the geological development of carbonate islands, offering valuable context for how long-term environmental changes have shaped their structure and evolution. By combining rigorous science with culturally respectful engagement, we aim to support the Cook Islands in safeguarding both its natural environment and its cultural legacy for generations to come.

Capacity and capability building (300-600 words)

A key objective of our project is to ensure that the outcomes benefit local communities and institutions by fostering opportunities for Cook Islanders to participate in and sustain environmental research well into the future.

To this end, we have initiated communications with Mr. Wayne King, the Director of the Climate Change Division for the Cook Islands. Mr. King has expressed strong interest in our proposed research and has signaled his support for collaboration. He has indicated his willingness to facilitate connections with the Central Policy and Planning Office, which could be a step in integrating our scientific work with national climate adaptation strategies. This relationship also opens the door to aligning our research objectives with local policy priorities, ensuring that our findings have direct applicability

and relevance.

Through our developing partnerships, we are hoping to include local scientists, students, and/or collaborators to join our field campaign. One of our goals is to involve Cook Island students in the field campaigns, where they will gain hands-on experience using scientific instruments and conducting geological assessments. Moreover, we are committed to a two-way knowledge exchange. While we bring external expertise, we fully recognize and value local knowledge and cultural perspectives. Our fieldwork activities are being designed with this in mind, ensuring that collaboration is respectful, reciprocal, and grounded in the local context.

In terms of long-term capacity building, we hope that this research can serve as a catalyst for new partnerships between our institutions and Cook Islands-based agencies and schools.

Sample collection (300-500 words)

Sample collection: As part of this research project, we plan to collect approximately 50 small fossilized coral samples (hand samples) from in-growth positions. These samples will be specifically targeted for their potential Last Interglacial age.

Sample locations: Our sample collection will take place across several islands in the southern Cook Islands, including Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke. The primary sampling sites will be located along the coastal margins of these islands, where fossilized coral terraces or outcrops are exposed. These coastal settings provide the best access to well-preserved corals in their original growth positions.

Sample usage: Each hand sample collected will be processed through a detailed series of laboratory analyses. Initially, we will cut ~1 cm thick slabs from each coral sample to assess internal structure and preservation. From these slabs, the most well-preserved sections will be selected for further geochemical and geochronological analysis. Specifically, ~ 1 g powdered sample will be first used for X-ray Diffraction to determine the mineralogical composition of each coral, which is critical for verifying whether primary aragonite (the original coral skeleton mineral) has been preserved or altered. Next, from this powder we use ~100–120 mg for U-Th age determination. This high-precision radiometric technique will allow us to establish the ages of the corals and thus infer sea-level history during the Last Interglacial period.

Sample storage: All unused sample materials will be securely stored at our collaborating institutions, either at the Lamont-Doherty Earth Observatory (LDEO) or the University of Florida (UF), depending on the laboratory where each phase of analysis is conducted. These remaining materials will be archived for potential future reanalysis or further study, subject to appropriate data-sharing agreements and ethical guidelines.

Dissemination process (200-500 words)

Data collected during field activities will include high precision GPS data and 3D photogrammetric models of field sites, which will be shared with Cook Island collaborators and interested parties following processing. We are also very interested to connect with Cook Island media outlets to develop outreach material about this project and about the results as they are published in scientific journals. Outside of the Cook Islands, project results will be disseminated through various outreach events, to increase public engagement with science. Planned outreach events include the Lamont-Doherty Earth Observatory (LDEO) Open House (which welcomes ~ 2000 visitors of all ages each year to the campus for a day of science engagement), exhibits at the American Museum of Natural History in New York City, a collaboration with the

Florida Museum of Natural History, and the annual Science for Alaska lecture series. Success will be measured by the number of participants at these events, as well as their engagement with our specific outreach components.

4. Ethics approval

Name of the Ethics Committee	N/A
Start and end date of ethics approval	N/A
Reference number	N/A
Email contact of Chair Ethics Committee	N/A
Attach ethics approval letter	No

Type of research

(Please tick relevant box)

Research commissioned or funded by a:

- ☐ Public/private sector agency in the Cook Islands
☐ Donor agency
☒ Other

5. Intellectual Property

Does the research project have potential to develop intellectual property

☐ Yes ☒ No

If yes – Describe what agreement has been reached between research investigators/research participants/ research funder/agency as to the ownership of raw data and research findings.

6. Permit Fee

If your research project is approved a permit fee of \$80.00 will be charged for the permit.

7. Check list

Have you attached the following:

- ☒ A two page CV of the principal investigator
☒ A two page CV of other named investigator
☐ A two page CV of the Cook Islands named investigator
☒ A copy of your current photo identification
☒ Letter of support from your host institution
☐ Ethics approval letter

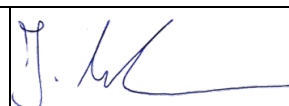
8. Declarations

Principal investigator/s

The information supplied in this application is accurate. I understand that if there are any changes to the ethics approval from Columbia University. I will inform the National Cook Islands Research Committee. I will:

- Uphold the Researcher Code of Conduct of Columbia University
- Comply with the conditions of the research permit
- Comply with the conditions of ethics approval
- Comply with the conditions of my immigration permit
- Provide a preliminary report of research findings to the CINRC
- Ensure any publications emanating from the research will be accessible to research participants
- Provide two hard copies and one e-copy of the published findings of the research to CINRC

Signed



Signed	
Date	Oct 15, 2025
Host Institution Research Office	
I have the delegated authority to sign this on behalf of the Lamont-Doherty Earth Observatory. I have read the application and support it. I understand that Columbia University is responsible for ensuring that any research conducted under its auspices will comply with the conditions of the ethics approval and the Cook Islands research permit. I understand that researcher non-compliance with the conditions of ethics approval and Cook Islands research permit will be referred to the Research Office of Columbia University.	
Signed	
Designation	Interim Director Lamont-Doherty Earth Observatory Columbia University
Date	October 16, 2025

1. Requires further support from Climate Change and NES.

We have met with Mr. Wayne King, who expressed interest in supporting this research and our permit application. We anticipate that this support may include identifying a local counterpart and, if appropriate, providing a letter of support to accompany the application. We also discussed our enthusiasm for engaging Cook Island students in our field efforts and scientific discussions.

2. Resource local counterpart this could include letter of support from local counterpart.

Please see answer above.

3. Question around location of sites and why?

This project aims to understand how sea level has changed in the past across the southern Cook Islands by studying fossilized coral reefs that formed when sea level was higher than today. These fossil reefs act like natural markers, allowing us to compare past sea levels between islands and determine whether differences are due to natural land movement or changes in the ocean itself. We target the southern Cook Islands because there is documented evidence of raised ancient coral reefs, but existing elevation measurements and age determinations are not precise enough to test hypotheses about past sea level changes.

The southern Cook Islands: Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke, were formed long ago by volcanoes that are no longer active and are now rimmed by modern coral reefs and carbonate sediments. Around the central volcanic hills of each island are flat, rocky areas made of ancient reef limestone, which preserve fossil corals that grew when sea level was higher than it is today during the Last Interglacial (LIG) and the early Holocene. Fossils from The Holocene show that sea level at that time was about 1.8 meters higher than present across all the islands, but fossils from LIG show much larger differences between islands, ranging from about 2.5 to over 12 meters higher than today. These large differences are unlikely to be caused simply by volcanic processes or sinking of the islands, because the volcanoes are very old and should have already settled by that time. Moreover, if subsidence of Rarotonga, the youngest volcano at ~2 Ma, was responsible for uplifting the surrounding islands, the LIG reef on Rarotonga would lie well below sea level rather than at ~3 m above present sea level. To understand whether these differences reflect real changes in sea level, movements of the land itself, or misidentification by previous researchers, more precise measurements of the age and elevation of these ancient reefs are needed. By studying the limestone geology on Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke, this project will help identify any land movement, account for local geological effects, and improve reconstructions of past sea levels across the southern Cook Islands.

4. More information on storage of samples.

All hand samples collected for this project will be securely stored at our respective home institutions, either at the Lamont-Doherty Earth Observatory (LDEO) or the University of Florida (UF), depending on the laboratory in which each phase of analytical work is performed. Upon arrival at the lab, each hand sample will be slabbled into two components: a working slab and an archive slab. Both slabs will be carefully and permanently labeled following standard geological curation protocols, and a corresponding digital catalog will be created to record key metadata (sample ID, provenance, preparation date, storage location, and any subsequent subsampling information).

The working slab will be used for all destructive analyses. It will be drilled for U–Th sampling, and a small ~100–200 mg aliquot will be extracted in the ultra-clean laboratory for chemical preparation and U–Th dating. Where analytical replication is required, additional material may be removed from the same working slab, and the slab may be resampled multiple times as needed to ensure data quality and reproducibility.

Any remaining material, including offcuts from sample preparation and the intact archive slab, will be securely stored in appropriate sample bags, or archival boxes designed to prevent contamination, degradation, or loss. These materials will remain in curated storage at either LDEO or UF to ensure their long-term preservation. The archive slabs will be maintained as permanent reference material, enabling potential reanalysis, application of new analytical techniques, or future collaborative studies.

Access to stored samples will follow appropriate data-sharing agreements, institutional policies, and ethical guidelines. Requests for further use of the material will be evaluated to ensure responsible stewardship and to maintain the scientific integrity of the archived collection.

5. Requires Island awareness & support. It will be very important to create island awareness and support possibly through the island council etc.

We recognize the importance of island awareness and local support for this research. We are committed to engaging with relevant island authorities and communities before and during fieldwork and would welcome guidance on the appropriate points of contact, such as Island Councils or other local governance bodies, for Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke. We are also enthusiastic about engaging local students in the fieldwork process, and scientific discussions. We respectfully request assistance in identifying the correct contacts to ensure that our work is well communicated, culturally appropriate, and supported at the island level.