FUNDACIÓN LEONARDO TORRES QUEVEDO
OF THE UNIVERSITY OF CANTABRIA

as the Client

- and -

NATIONAL INSTITUTE OF WATER
AND ATMOSPHERIC RESEARCH LIMITED

as the Contractor

CONTRACT FOR SERVICES

Assistance in developing an open-source tsunami inundation forecast system for Tonga and Samoa

Under FJ-SPC-157811-CS-QC BS, Pacific Resilience Program (P 147839)

THIS AGREEMENT is made on this 5th day of April **2021**

BETWEEN:

(1) **FUNDACIÓN LEONARDO TORRES QUEVEDO OF THE UNIVERSITY OF CANTABRIA**, a non-profit organisation and educational body governed by the laws of Spain and having its registered office at Av. de los Castros, s/n, 39005 Santander, Cantabria, Spain (**"Client"**); and

(2) **NATIONAL INSTITUTE OF WATER AND ATMOSPHERIC RESEARCH LIMITED** (NZBN: 9429038971433), a company duly incorporated under the laws of New Zealand, and having its registered office at 41 Market Place, Viaduct Harbour, Auckland, New Zealand (NIWA) ("**Contractor**")

(each a "Party" and collectively the "Parties")

BACKGROUND

A. The Client has been contracted by the Pacific Community ("SPC") under Project FJ-SPC-157811-CS-QC BS, Pacific Resilience Program (P 147839) ("SPC Programme").

B. The Client requires technical assistance for the development of a tsunami flooding prediction system for Tonga and Samoa as part of the SPC Programme.

C. For this purpose, an open tender process was initiated to contract a company that had experience in the undertaking of this type of work in accordance with the provisions of article 156 of Law 9/2017, of November 8, on Public Sector Contracts of Spain ("Tender"). The Contractor submitted a proposal for the work in response to this tender as appended at Schedule C ("Proposal").

D. As a result of the aforementioned process, the Client awarded the Contractor to carry out the works mentioned in point C as detailed in the Proposal.

E. The Contractor agrees to provide those works upon the terms and conditions set out in this Agreement and in accordance with the applicable specific administrative clauses and technical requirements of the Tender set out in Schedule B as specifically incorporated into this Agreement.

1. APPOINTMENT AND TERM

1.1 **Appointment**:

The Client hereby appoints the Contractor to provide the services described in Schedule A ("Services") and deliver the deliverables/outputs described in Schedule A ("Deliverables") on the terms and conditions set out in this Agreement, and the Contractor accepts that appointment and the terms and conditions contained herein.

1.2 **Term**:

This Agreement commences on the start date and ends on the finish date specified in Schedule A or the date the Deliverables are completed, if later, unless agreed otherwise or terminated earlier in accordance with this Agreement ("Term"). This Agreement can have retrospective effect if the start date precedes the date of the Agreement.

2. SERVICES

2.1. SPC-led variation:

The Services to be provided by the Contractor are subject to ongoing funding for the SPC Programme from SPC as well as the Client's administrative law requirements of its jurisdiction. If SPC changes the funding, research priorities and/or objectives of the SPC Programme, or if the Client reasonably believes variations to the Agreement are required for reasons of public interest, then the Client may request a variation to the Services (and associated remuneration) to be provided by the Contractor. Any variation pursuant to this clause shall only be made after consulting in good faith with, and subject to the agreement of, the Contractor. If the Parties cannot reach agreement on a variation under this clause within 15 Business Days of the variation request, either the Client or the Contractor may immediately terminate this Agreement by written notice to the other Party.

2.2. **Supply**:

Subject to clause 2.5, the Contractor shall perform the Services and deliver the Deliverables in accordance with and subject to the terms of this Agreement, including any variations agreed by the Parties.

If at any time during this Agreement the Contractor is no longer able to supply the Services or any Deliverable the Contractor must notify immediately the Client and either Party may terminate this Agreement. This provision is not intended to cover the situation where the Contractor is prevented or delayed from performing its obligations under the Agreement for a temporary or prolonged period because of the occurrence of a "force majeure event" as provided for under clause 12.7.

2.3. **Skill and Diligence**:

The Contractor will:

(a) carry out, and ensure that its employees, servants, agents and/or approved subcontractors carry out, the Services and deliver the Deliverables with all due care, skill, diligence and efficiency, which would ordinarily be expected from a competent professional, performing the same or similar services as those contemplated by this Agreement and to the required performance standards and quality set out in Schedule A or reasonably notified by the Client from time to time;
(b) ensure that any statements, opinions and reports it gives are given in good faith (upon reasonable grounds) and upon the belief that such statements, opinions and reports are accurate, correct and not misleading.
(c) comply with all applicable laws, regulations and codes of conduct (including without limitation any applicable environmental, labour and human rights laws)
(d) ensure that the Services shall be performed by the Contractor's key personnel specified in Schedule A (if any), or a substitute with comparable skills and experience appointed by the Contractor;
(e) reperform the Services or Deliverables if they do not meet the standards set out in this Agreement and the reasonable requirements of the Client within a reasonable timeframe.

2.4. **Reports and Audit**:

The Contractor will keep accurate and systematic records in relation to the Services and Deliverables, and provide the Client with such information related to the Services and Deliverables as it may reasonably require. The Client may inspect the Contractor's records or provision of the Services on reasonable request for the purposes of ensuring the Contractor's compliance with this Agreement or the terms of the SPC Programme, and the Contractor agrees to provide reasonable access and information to the Client, its authorised agents or any auditors, reviewers or evaluators for such purposes.

2.5. **Dependencies:**

The Client acknowledges that the Contractor's ability to provide the Services and deliver the Deliverables is dependent on certain factors occurring or not occurring as described in Schedule A. In the event that the occurrence or non-occurrence of a dependency affects the Contractor's ability to provide the Services or deliver the Deliverables, then the Contractor shall notify the Client as soon as practicable and the Parties shall consult in good faith to agree an extension of time, variation to the Services and/or variation to the remuneration payable accordingly.

2.6. General Obligations

Both Parties agree to:

(a) act in good faith and honestly with their dealings with each other,
(b) discuss matters affecting this Agreement or the delivery of the Services as needed;
(c) provide any information or assistance reasonably required by the other Party for the provision of the Services within the context of the wider SPC Programme, and
(d) notify each other promptly of any actual or anticipated issues that could impact on the Services or the Agreement.

2.7. Proposal and Tender

In submitting its Proposal for the Services under this Agreement, the Contractor warrants:

(a) it has complied with any specific tender requirements and conditions notified to it by the Client prior to submission for the Tender, and

(b) any representations made and information given by it in its Proposal were true and correct as at the date of submission.

In awarding the contract for the Services and negotiating this Agreement, the Client warrants it has complied with all applicable laws and regulations of its jurisdiction, including Law 9/2017, of November 8, on Public Sector Contracts of Spain and any applicable specific administrative clauses and technical requirements of the Tender as set out in Schedule B.

3. REMUNERATION

3.1 **Payment provisions**:

The Client will pay the Contractor promptly for Services and Deliverables performed pursuant to this Agreement in the amounts, at the times and in the manner set out in Schedule A. Except as specified in Schedule A or agreed otherwise in writing by the Client, the payment amounts listed in Schedule A are the maximum amount payable for the Services and Deliverables and are inclusive of all taxes, royalties and levies.

3.2 **Invoicing:**

The Contractor will render its invoices in accordance with the timetable set out in Schedule A.

3.3 **Interest**:
No interest is payable by the Client in respect of payments to be made by the Client to the Contractor under this Agreement.

3.4 **Currency**:

All amounts payable under this Agreement and amounts referred to in Schedule A are in US dollars.

4. OUTSIDE ASSISTANCE AND MATERIALS

4.1 **Third parties**:

The Contractor may not subcontract the provision of the Services or delivery of the Deliverables to a third party without the prior written approval by the Client (which shall not be unreasonably withheld).

4.2 **Ownership**:

Unless expressly agreed otherwise, the Contractor shall own materials, instruments or equipment supplied or acquired by the Contractor for the performance of the Services and delivery of the Deliverables under this Agreement.

5. HEALTH AND SAFETY

5.1 **General obligations:**

In accordance with the Health and Safety at Work Act 2015 (NZ), the Parties will consult with each other, and with any subcontractors or anyone else involved in the work, to manage all hazards and risks that they can each influence. Each Party is responsible for complying with its own statutory obligations, and nothing in this Agreement changes that. The Parties each agree to comply with all of their obligations under this clause 5 as soon as reasonably practicable.

5.2 **Consideration of risks and hazards**:

The Client will inform the Contractor of any of the work it considers to be hazardous and any measures to manage the hazards and risks that are required by regulation, by industry practice, or by the Client (acting reasonably), including, where applicable, as set out in the Client's health and safety plans.

The Contractor will prepare a health and safety plan for the work (the "Plan"). This must identify all anticipated hazards and risks and measures to manage those hazards and risks, including any identified by the Client. The Contractor will provide the Plan to the Client for their review and feedback and will then revise it to address that feedback.

It is desirable that all the requirements of this clause 5.2 are completed before this Agreement is finalised, but in any event they must be completed before work starts.

5.3 **Ongoing compliance with and maintenance of the Plan:**

The Parties will comply with the Plan. The Contractor will take all reasonably practicable steps to comply with any other reasonable health and safety request made by the Client. Should either Party be in default of any of its health and safety obligations under this Agreement and the other Party reasonably considers that it is unsafe for the Contractor to continue to provide the Services, the other Party may require the suspension of performance of the Services until the default is rectified.

The duty of the Parties to consult with each other to manage health and safety hazards and risks continues throughout the Term. If at any stage during the Term either Party identifies a hazard or risk related to the work that is not addressed in the Plan, the Contractor shall update the Plan using the process set out in clause 5.2 above.

The Parties and any subcontractors shall meet at regular intervals and at the end of the Term to review health and safety matters and to agree any changes or improvements to health and safety processes. Where applicable, the Contractor must update the Plan to reflect these. The Client may at any time monitor and check the Contractor's activities to ensure that they comply with the Plan. The Contractor must provide whatever access and information the Client requests to enable this.

5.4 **Variations due to safety hazards or risks:**

The Contractor shall notify the Client if it reasonably believes that due to circumstances identified after this Agreement is finalised the safe management of a hazard or risk is likely to affect its ability to provide the Services or deliver the Deliverables. The Parties shall then consult in good faith to agree an extension of

time, variation to the Services, variation to the remuneration payable and/or termination of this Agreement.

5.5 **Subcontractors:**

The Contractor will take all reasonably practicable steps to assure itself that, from a health and safety perspective, each subcontractor is competent to undertake the work required of it before it commences work, and will provide the Client with any information it requires to assess whether to approve the subcontractor. The Contractor shall take all reasonably practicable steps to ensure that all subcontractors are aware of and comply with the Plan and any other reasonable health and safety request made by the Client together with the other obligations in this clause 5 to the extent applicable to the work they are undertaking.

5.6 **Notification:**

The Contractor shall immediately notify the Client if any of the following occur during the Term:

(a) the death of a person; or

(b) any work-related personal harm requiring medical treatment greater than first aid or resulting in at least one full day off work; or

(c) a notifiable incident; or

(d) the notification to WorkSafe of a notifiable event,

with notifiable incident and notifiable event having the meaning given in the Health and Safety at Work Act 2015.

6. INTELLECTUAL PROPERTY

6.1 **Definition**:

For the purposes of this Agreement:

"**CLiDEsc Portal**" is NIWA's web-platform based on open source technology for displaying climate data and forecast products.

"**Intellectual Property**" means any patent, trade mark, service mark, copyright, moral right, right in a design, know-how, trade names, domain names, database rights, inventions, trade secrets, confidential information and any other rights of a similar nature, whether registered, in the course of being registered or unregistered (and any right to register), and any analogous rights worldwide.

"**Pre-existing Intellectual Property**" means:

- any Intellectual Property that existed prior to the date of this Agreement and used for the purposes of providing the Services or Deliverables or is otherwise used under or pursuant to this Agreement;

- all Intellectual Property created independently of this Agreement and used for the purposes of providing the Services or Deliverables or is otherwise used under or pursuant to this Agreement; and

- any Intellectual Property which is an amendment, improvement or adaptation made to any Pre-existing Intellectual Property under or pursuant to this Agreement, and which is not able to be used independently of the Pre-existing Intellectual Property.

For the avoidance of doubt, CLiDEsc Portal is Pre-existing Intellectual Property of NIWA. Any amendments, improvements or adaptations of CLiDEsc Portal under this Agreement that form part of the Services and that cannot be used independently of it (including the portal integration work to CLiDEsc Portal) will remain vested in NIWA.

"**New Intellectual Property"** means any Intellectual Property produced pursuant to or created under this Agreement, which is able to be used independently of any Pre-existing Intellectual Property, but does not include Intellectual Property in data, metadata or factual information.

"Residuals" means technical information related to the Services or the Deliverables in non-tangible form, which may be retained in a person's memory unaided including ideas, concepts, know-how or techniques contained therein.

6.2 **Pre-existing Intellectual Property**:

All Pre-existing Intellectual Property shall remain the property of the Party owning such Pre-existing Intellectual Property or providing or otherwise making available such Intellectual Property under this Agreement.

The Contractor grants to the Client a non-exclusive, perpetual, royalty-free licence to use, copy and modify any of the Contractor's Pre-existing Intellectual Property utilised in the Deliverables provided that Contractor's Pre-existing Intellectual Property must remain incorporated in, and must not be used, developed, sold, licensed or distributed in a manner that is or allows it to be used separately from, the Deliverables.

The Client grants to the Contractor a non-exclusive, perpetual, royalty-free licence to use, copy and modify any of the Client's Pre-existing Intellectual Property, and any of the Client's Intellectual Property created under the Agreement, as is necessary for the purposes of the Contactor performing its obligations or exercising its rights set out in this Agreement.

6.3 **New Intellectual Property**:

Subject to the Client paying the Contractor in full all remuneration due under this Agreement relating to any specific New Intellectual Property, then that New Intellectual Property incorporated into the Deliverables shall be jointly owned by the Parties. Each Party irrevocably grants to the other a non-exclusive, perpetual, royalty-free licence to use, copy and modify the New Intellectual Property for any purpose. Despite the foregoing, any New Intellectual Property in the forecast system code will be owned by the Client and made publicly available under an appropriate open source licence.

All New Intellectual Property which is not incorporated into the Deliverables shall be owned by the Contractor.

The Contractor does not warrant the suitability of the New Intellectual Property or the Contractor's Pre-existing Intellectual Property for any purpose other than use as part of the Deliverables or any other use stated in this Agreement.

6.4 **Data and factual information**:

The ownership of the rights in data, metadata and factual information collected or created by the Contractor in the course of providing the Services or Deliverables or otherwise created under this Agreement shall, upon full compliance by the Client with its obligations under clause 3, vest solely, exclusively and absolutely in the Client.

6.5 **Attribution:**

The Client shall attribute any use of New Intellectual Property together with any permitted use or disclosure of any of the following owned by the Contractor:

- Pre-existing Intellectual Property;
- Data, metadata or factual information;

(including any use as part of a Deliverable) in such a way as to expressly identify the Contractor as the source of it.

6.6 **Residuals**

Nothing in this Agreement shall be construed to limit either Party's right to:

(a) independently use the Residuals resulting from their involvement in this Agreement; and

(b) acquire, licence, provide, develop or commercialise for itself or others (or to have others acquire, licence, provide, develop or commercialise for it) the same or similar technology, services and/or products as contemplated by this Agreement,

provided that any such use or action does not breach the other Party's rights to the Intellectual Property or confidentiality.

7. CONFIDENTIALITY

7.1 **Confidential Information:**

Each Party will, during the course of this Agreement, learn and have access to confidential information of and/or about the other Party. Such information includes information which is either identified by the disclosing Party as being confidential, or which by its nature may reasonably be regarded as being sensitive and/or of commercial value to the other Party and therefore confidential, and may include (but is not restricted to) personnel, structures, finances, business strategies or arrangements, research and/or development activities or plans, product information, manufacturing information, testing methods or results, data and data analysis techniques ("Confidential Information").

7.2 **No disclosure or use**:

Both Parties agree to keep Confidential Information about the other, and its activities, confidential and not to disclose or use the Confidential Information in any way until such time as the Confidential Information enters the public domain, other than by way of breach of this Agreement, or the other Party consents in writing to such disclosure. Notwithstanding such confidentiality obligations, the Contractor may disclose or use any Confidential Information to the extent necessary for it to perform the Services and deliver the Deliverables under this Agreement, and either Party may disclose any Confidential Information where required to disclose it by law (including pursuant to clause 7.3 below).

7.3 **OIA disclosure**:

The Client acknowledges that the Contractor, as a Crown Research Institute, is subject to the provisions of the Official Information Act 1982 (NZ) ("OIA") and agrees that the Contractor may disclose information relating to this Agreement (which may include Confidential Information) to the extent required to comply with its obligations under the OIA.

7.4 **Employees**:

The Parties will only give access to Confidential Information to those employees who need to have access to that information to enable such Party to fulfil its obligations under this Agreement. Prior to such disclosure, the disclosing Party will advise those employees of the confidential nature of that information and its confidentiality obligations under this Agreement, and will ensure such employees are bound by the same obligations of confidence.

7.5 **Third parties**:

(a) Where a Party wants to disclose any Confidential Information to a third party, for the purposes of enabling that third party to assist in the provision of the Services or delivery of the Deliverables, that Party shall notify the other Party of its intention to disclose, the nature and extent of that disclosure and identify the party to whom disclosure will be made;

(b) The Party seeking to disclose shall only disclose that Confidential Information after receiving express written agreement from the other Party; and

(c) Prior to disclosing any Confidential Information, the disclosing Party will advise the third party of its confidentiality obligations under this Agreement, and ensure the third party is bound by the same obligations of confidence.

7.6 **Security**:

The Parties will use all reasonable endeavours to protect all information and materials provided by the other Party, in its possession, power or control and connected with this Agreement from unauthorised access, or use, by a third party or misuse, damage or destruction by any person.

7.7 **Delivery up**:

Upon termination or expiration of this Agreement, for whatever reason, the Parties will, cease to use, and will upon request deliver up to the other Party all documents, information, data and other material relating to or connected with the Confidential Information arising from this Agreement and all copies and duplicates of those items. However, a Party may retain one copy of any Confidential Information, solely for record keeping purposes, reasonably necessary to fulfil its obligations pursuant to the Public Records Act 2005 (NZ) or equivalent legislation in that Party's jurisdiction.

8. PUBLICITY / ENDORSEMENT

8.1 **Name**:

A Party will not refer to the other Party in any way (including but not limited to reference to business location and employees) or to any aspect of the existence or terms of this Agreement, to promote itself or its products in any manner without the prior written consent of the other Party.

8.2 **Statement**:

The Parties will not make any statement on behalf of the other Party or any client of the other Party, or by any action, statement or omission do anything which may cause the other Party or any client of the other Party to be brought into disrepute.

9. SUSPENSION AND TERMINATION

9.1 **Suspension of obligations**:

(a) The Client may suspend all or any part of the Services on written notice to the Contractor if it reasonably believes that suspension is in the public interest.
(b) If suspension under clause 9.1(a) continues for a period of more than two months, then the Contractor may terminate this Agreement on written notice and claim reasonable costs incurred or suffered as a result of the suspension.

9.2 **Termination for cause**:

If a Party defaults in the performance of any of its duties or obligations under this Agreement and the default is not reasonably capable of remedy or, if it is reasonably capable of remedy is not remedied to the other Party's reasonable satisfaction within fourteen (14) days of the other Party providing the defaulting Party with written notice specifying the default, then the other Party may, by giving written notice to the defaulting Party, terminate this Agreement.

9.3 **Termination by agreement**:

The Parties may terminate this Agreement on mutual written agreement.

9.4 **Termination without prejudice**:

Suspension or termination of this Agreement for any reason will not prejudice or affect the accrued rights or claims or liabilities of the Parties.

9.5 **Obligations on Termination**

(a) On giving or receiving a notice of termination, the Contractor will promptly do everything reasonably possible to reduce its losses, costs and expenses arising from the termination of this Agreement.
(b) Upon termination of this Agreement for any reason and subject to clause 9.5(c) below, the Client shall pay the Contractor for any work undertaken in whole or in part in performance of the Services (including any Deliverables developed in part but not yet delivered) up to the date of termination, and any reasonable committed costs and expenses.
(c) On termination by the Client under clause 9.2, the Client may withhold any payment due until the breach is remedied to the Client's reasonable satisfaction and/ or, if the breach is not remedied within a reasonable timeframe, the Client may deduct a reasonable amount from the payment due to reflect the reduced value of the Services to the Client.
(d) The Contractor will return to the Client any monies paid in advance by the Client under this Agreement upon termination that are unexpended or uncommitted as at the date of termination.

10. DISPUTES

10.1 **Dispute**:

For the purposes of this clause, a "Dispute" means any dispute, difference or claim arising out of or in connection with the Agreement, the object of the Agreement or the formation of the Agreement.

10.2 **Dispute resolution procedure**

In the event of a Dispute:

(a) a Party will give written notice of the Dispute to the other Party as soon as practicable ("Dispute Notice").

(b) The Parties will use their best efforts to try and try settle the Dispute amicably through negotiation, consultation and discussion within 30 days of receipt of the Dispute Notice.

(c) any Dispute that remains unresolved 30 days after receipt of the Dispute Notice, shall be settled by arbitration. The seat or legal place of the arbitration shall be Auckland, New Zealand. The number of arbitrators shall be one. The New Zealand Arbitration Act 1996 shall govern the arbitration, and all provisions of the First and Second Schedules to that Act shall apply except Article 5 of the Second Schedule, the parties agreeing that there shall be no right of appeal from the arbitrator's award and such decision shall be final and binding;

(d) . The Parties agree that the language used for dealing with any Dispute and in arbitral proceedings will be English.

(e) Despite anything in this clause, either Party may at any point seek urgent injunctive or interim relief from a court of competent jurisdiction.

11. LIABILITY

11.1 **Limitation of contractual liability**:

A Party's total maximum liability under or in connection with this Agreement (including under any indemnity):

(a) will not exceed three times the total amount payable by the Client to the Contractor under the Agreement, and

(b) is limited to losses caused directly by the Party, and

(c) will not under any circumstances include any liability for loss of revenue or profits, or any consequential, indirect or special loss.

Furthermore, each Party will take reasonable steps to mitigate any loss or damage suffered or incurred as a result of other Party's breach or default and, without limiting this obligation, a Party will only be liable to the other to the proportional extent of its contribution to any loss or damage.

11.2 **Exclusions to limitations**

The exclusions and limitations of liability stated in clause 11.1 will not apply in the case of liability:

(a) for fraud or for damage caused by wilful misconduct, or
(b) for death or personal injury caused by negligence, or
(c) for a breach of clauses 6 (intellectual property) or 7 (confidentiality)

12. MISCELLANEOUS

12.1 **Notices**:

(a) Any notice given under this Agreement may be served by hand or courier, by prepaid registered post or by completed email transmission, to the last known business address of the Party to whom it is given.

(b) Any notice will be deemed to have been served:

- on the date it is delivered where delivered by hand or by courier;
- after ten Business Days from the date of being posted if sent by post, or
- eight hours after confirmation of receipt of transmission if sent by email.

Proof that the notice was properly addressed and sent is sufficient evidence of service.

(c) Notices served after 17:00 on a Business Day, or on a day which is not a Business Day, shall be deemed to have been served on the next succeeding Business Day.

For the purposes of this clause, "Business Day" means a normal working day between the hours of the 08:30 – 17:00 in the place of receipt of the notice.

12.2 **Entire agreement**:

(a) This Agreement (together with the applicable Schedule(s)) constitutes the entire agreement between the Parties with respect to the Services and the Deliverables.

(b) This Agreement supersedes all prior understandings between the Parties with respect to the Services, whether written or oral, which will be of no further force or effect.

12.3 **No-waiver**:

(a) No failure or delay on the part of either Party in exercising any power or right under this Agreement will operate as a waiver, or as an affirmation of the Agreement, nor will any single or partial exercise of such right or power preclude any other or future exercise of the same or any other right or power under this Agreement.

(b) No waiver by either Party of any provision of this Agreement will be binding unless expressly made and confirmed in writing by the Party and the other Party to this Agreement. Further, any such waiver will relate only to such matter, non-compliance or breach to which it expressly relates and will not apply to any subsequent non-compliance, breach, or other matter.

12.4 **Insurance**:

The Contractor is responsible for the risks and liabilities it assumes under the Agreement and will ensure it has adequate and appropriate insurance cover for the provision of the Services and delivery of the Deliverables including (but not limited to) public liability and professional indemnity/ civil liability insurance cover for the Term and for a period of at least twelve (12) months following termination or expiration of the Agreement.

12.5 **Contractor arrangement**:

(a) Nothing in this Agreement creates a partnership, employment relationship or agency between the Parties. The Contractor is an independent contractor and does not have any right or power to bind or act on behalf of the Client without the Client's written consent.

(b) As an independent contractor, the Contractor is liable for all its own taxes and levies relating to it or any of its employees, agents or contractors.

12.6 **Assignment**:

(a) The Parties will not assign or otherwise transfer the benefits and obligations under this Agreement to any other party unless it receives the prior written consent of the other Party (acting reasonably).

(b) This Agreement will be binding upon, and inure to the benefit of, all successors, licensees, trustees and permitted assigns of the Parties.

12.7 **Force Majeure**:

(a) Force majeure events include any circumstances beyond the reasonable control of a Party, including but not limited to: acts of God, significantly adverse environmental conditions, epidemics or pandemics (including without limitation the Coronavirus disease (Covid-19)), accident, insurrection, civil disturbance; any acts, restrictions, regulations, by-laws, prohibitions or measures of any kind on the part of any governmental, parliamentary or local authority; or industrial action or trade disputes, except where restricted to employees of a Party, but a force majeure event shall not include the effects of insolvency or other financial difficulty.

(b) Neither Party shall be liable for a breach of its obligations under this Agreement to the extent that performance of such obligations is prevented or delayed by a force majeure event.

(c) If a force majeure event prevents or delays a Party from performing its obligations under this Agreement then the relevant Party shall:

- promptly notify the other Party giving particulars of the force majeure event, how it is preventing or delaying performance of its obligations and the likely period of such prevention or delay;
- make reasonable efforts to mitigate the effect of the force majeure event and to fulfil its obligations under the Agreement as far as is reasonably practicable, and
- recommence performance of its obligations under this Agreement as soon as reasonably practicable once the force majeure event has ended.

(d) On notification under clause 12.7(c), the Parties will consult with each other in good faith, and, as appropriate, to agree a revised timetable for the Services, appropriate payment terms for any Services performed prior to the force majeure event (to the extent not adequately addressed through the Client's existing payment obligations), changes to the Deliverables or alternative strategies or arrangements to help overcome or better mitigate the effects of the force majeure event.

(e) If a force majeure event prevents or delays a Party from performing its obligations under this Agreement for a period of sixty (60) consecutive Business Days, then either Party may (subject to the cessation of the force

majeure event or agreement between the Parties under clause 12.7(d)) terminate this Agreement upon ten (10) Business Days' notice.

12.8 **Variation**:

No modification, alteration or addition to this Agreement will be binding upon the Parties unless it is in writing, and is signed by or agreed to by, authorised representatives of both Parties.

12.9 **Survival**:

The provisions of this Agreement which by their nature survive termination, or expiry of this Agreement or which are expressly stated to survive termination, including (but not limited to) intellectual property, confidentiality, publicity, endorsement and liability or any other remedies at law, shall survive termination of this Agreement.

12.10 **Severabilty**:

If any provision of the Agreement is void or unenforceable, for any reason, the remainder of the Agreement will remain in full force and effect and will not be terminated.

12.11 **Counterparts**:

(a) This Agreement may be signed in any number of counterparts (including scanned and emailed copies), which taken together will constitute a binding and enforceable agreement.

(b) Where a Party signs the Agreement electronically or transmits a signed copy electronically (whether by email or otherwise), then the other Party is entitled to rely on that copy (including the signatures) as being valid and complete, and its contents as accurately reproducing the original.

12.12 **Schedule B: Specific Administrative Clauses to be Applied**
The relevant specific clauses set out in Schedule B governing the Tender in accordance with Law 9/2017, of November 8, on Public Sector Contracts of Spain have been incorporated into the above clauses of this Agreement.

12.13 **Governing Law**:

This Agreement will be governed by and interpreted in accordance with the laws of Spain.

Signed: ..... Date: .....
(for FUNDACIÓN LEONARDO TORRES QUEVEDO OF THE UNIVERSITY OF CANTABRIA)

Firmado digitalmente por 71436884B
JORGE CASTRO (R: G39034608)
Fecha: 2021.04.16 09:56:47 +02'00'

Name: ....Jorge Castro.....

Position: Managing Director.....

Signed: ..... Date: 20/04/21
(for NIWA)

Name: John Morgan

Position: CEO

SCHEDULE A

TECHNICAL CHARACTERISTICS OF SERVICES

The Client, the Fundación Leonardo Torres Quevedo of the University of Cantabria ("FLTQ"), a non-profit organisation, has been contracted by the Pacific Community ("SPC") under Project FJ-SPC157811-CS-QC BS, Pacific Resilience Program (P 147839) and requires assistance in developing an open source tsunami driven inundation forecast system for Tonga and Samoa as part of the SPC Programme.

The Services and Deliverables to be completed by the Contractor to assist FLTQ with part of the SPC Programme consist of the following (as set out below and more fully particularised in Schedule C – the Proposal) :

1) Developing an open-source tsunami driven inundation forecast system using the metamodel approach.

2) Preparing technical and training material.

3) Facilitating the integration of forecasting products to the Samoa and Tonga CliDesc portals.

4) Assisting with training on deployment of ocean observation buoys by remotely training local teams and preparing technical and training material as appropriate.

NOTE: As set out in the Proposal, the Services do not include any boating activities nor the supply of any goods or equipment by the Contractor for the SPC Programme. FLTQ will organise for the ocean observation buoys and moorings it has procured for the SPC Programme to be delivered to the Contractor's specified location, and the Contractor will prepare the buoys as detailed in Schedule C before shipping the buoys to the agreed in-country delivery address. The Contractor will bear the risks for the buoys from the time they are delivered to its location until the buoys have been delivered in-country. FLTQ acknowledges and agrees that the Contractor has no responsibility or liability for procuring the buoys or the functioning, maintenance and deployment/ installation of the buoys and any other related equipment under the SPC Programme or for ensuring that the buoys/such equipment meets any particular quality or standard.
Except as expressly agreed otherwise with FLTQ, the Contractor is not responsible for obtaining any permits, licences, consents or customs clearances required for the SPC Programme as part of the Services (including as to the deployment of the buoys) but will provide reasonable assistance to FLTQ, its clients and suppliers to help obtain such permits, licences, consents or clearances.

TRANSPORTATION AND INSTALLATION

Unless otherwise set out in this Schedule, the remuneration for the Services includes all the costs required for the provision of the Services as set out in the Proposal, including VAT/ GST and the transport and assembly of the buoys by the Contractor as set out above.

TRAINING

Training course to be taught at least in four sessions in person or online, with a minimum duration of 3 hours per session, on a date to be determined by the FLTQ in consultation with the Contractor.

MAINTENANCE

The Contractor will maintain and support the CLiDEsc Portal for 2 years from the end date of this Agreement. While the Contractor will use all reasonable endeavours to maintain and support the CLiDEsc Portal, the Client acknowledges that the Contractor makes no representations or warranty that the Portal will be error-free or free from interruption or available at particular times, and that the Contractor may at any time and without notice modify or suspend operation of or access to the Portal as necessary to perform routine or non-routine, correct errors or perform other changes or updates to the Portal.

EXECUTION PERIOD

The Agreement will start on its signing and end 15 months from such date or the completion of the Deliverables in accordance with clause 1.2. The Project is expected to complete by June 2022 but may be extended in accordance with section 15 of clause 1 of Schedule B and the Parties' written agreement.

DEPENDENCIES

NIWA's delivery of the Services and Deliverables is dependent on:

- Sharing of early/draft versions of products for integration in CLiDEsc Portal for each forecast component (Seasonal outlook by 30 April 2021, Swell inundation by 30 June 2021, Tsunami by 30 October 2021).
- Access to a shared repository for the forecast system code (by 1 March 2021).
- The ocean observation buoys being delivered to the Contractor within the agreed timeframe and no shipping delays for their transportation to Samoa/ Tonga.
- Wave buoy deployment training will depend on local teams attending video-conference calls and online training sessions.
  The Client obtaining custom clearances including payment of any duty/taxes and transporting the buoys to the Contractor's premises.

The Parties acknowledge that the Coronavirus disease (Covid-19) is an ongoing event at the date of this Agreement, and that notwithstanding the Parties' awareness of the existence of that event, it may still constitute a "force majeure event" for the purposes of clause 12.7 (subject to the terms of that clause).

REMUNERATION

The total contract price for the Services and Deliverables is 176,200 USD.

PAYMENT SCHEDULE

In consideration for the performance of the Services, the FLTQ undertakes to pay the Contractor the contract price in the following instalments of that price as follows:

• 20% at the end of Month 1 – April 2021
• 20% at the end of Month 4 – July 2021
• 20% at the end of Month 7 – October 2021
• 20% at the end of Month 10 – January 2022
• 20% at the end of the work – Month 15 – and after the delivery of the System and Final Report – June 2022

The Contractor will invoice FLTQ the contract price in the amounts and times as set out above and FLTQ will pay each valid invoice within 60 days of its receipt.

SPECIAL PROVISIONS

The Parties acknowledge that there is inherent uncertainty in tsunami forecasting and modelling. While the Contractor will take all care in assisting the Client and relevant third-parties with the development of the tsunami forecast system/ model as part of the Services, the Client acknowledges that the Contractor is not responsible for any decision made or action taken by any party in reliance on that system or for any third party claim suffered by any party in respect of it or the wider products of the SPC Programme. If required, the Parties will work together in developing a mutually acceptable, appropriate disclaimer and/or terms of use to include in the forecast system or other forecasting products that are made available to third parties as part of the Services under this Agreement to reflect the uncertainties in tsunami forecasting and modelling and the other terms of this provision.

SCHEDULE B –

SCHEDULE OF SPECIFIC ADMINISTRATIVE CLAUSES TO BE APPLIED IN THE CONTRACTING OF ASSISTANCE SERVICES AS PART OF THE CONVENTION "IMPACT FORECASTING CONSULTANT´S SERVICES FOR THE PACIFIC COMMUNITY", TO BE AWARDED BY MEANS OF AN OPEN PROCESS WITH PLURALITY OF CRITERIA

SCHEDULE OF SPECIFIC ADMINISTRATIVE CLAUSES TO BE APPLIED IN THE CONTRACTING OF ASSISTANCE SERVICES AS PART OF THE CONVENTION "IMPACT FORECASTING CONSULTANT´S SERVICES FOR THE PACIFIC COMMUNITY", TO BE AWARDED BY MEANS OF AN OPEN PROCESS WITH PLURALITY OF CRITERIA

CHAPTER I. CHARACTERISTICS OF CONTRACT

Clause 1. Characteristics of contract.

The Leonardo Torres Quevedo Foundation for the promotion of technological research in the University of Cantabria (FLTQ), with Tax ID number G39034608, and registered office in the University College of Civil Engineering, Avenida de los Castros, Nº 44-3º planta, 39005-Santander, Spain, Europe, is a non-profit organization and has been contracted by Pacific Community ("SPC") for the undertaking of Project FJ- SPC-157811-CS-QC BS: Pacific Resilience Program (P-147839) and requires technical assistance for the development of a tsunami flooding prediction system for Tonga and Samoa. The activities :

- Tsunami driven inundation forecast system For Tonga and Samoa
- Prepare material and participate in training and capacity building activities
- Training on deployment of wave buoys
- Assist with integration of forecast system to the Meteorological services CLiDEsc Portal

For this purpose, an open process has been initiated to contract a company that has experience in the undertaking of this type of processes, in accordance with the provisions of article 156 of Law 9/2017, of November 8, on Public Sector Contracts.

1.- Definition of object of contract:

2.- Administrative Bodies

MANAGING, CONTRACTING, ACCOUNTING AND SUPERVISION BODY. By virtue of article 20 of the statutes of the Leonardo Torres Quevedo Foundation, the Board of Trustees, at the proposal of the President, may appoint a Managing Director with competences and powers of management, representation,administration and disposition, which will be granted in the corresponding appointment procedure, and registered in a public document. This appointment was made in Santander, on December 11, 2019, before the Notary of the Illustrious College of Cantabria, Mr. Emilio González-Madroño Gutierrez, with Protocol number No. 2648. The aforementioned public document was deposited in the Registry of the Protectorate of Foundations of the Government of Cantabria, dated December 16, 2019. In use of the aforementioned organizational powers, the Managing Director Mr. Jorge Castro González designated the composition of the Contracting Board of the Leonardo Torres Quevedo Foundation for the promotion of Technological Research at the University of Cantabria (FLTQ), which will be made up of the following members:

- Managing Director of FLTQ who will act as President of the Contracting Committee.
- The lead researcher of the Research Group requesting the service (member).
- The vice-director of FLTQ (member).
- The Secretary of the Foundation Board will act as the Secretary of the Contracting Board.

The research group of the University of Cantabria which is the promoter and requester of the service is the Geomatic and Oceanographic Engineering group (Geo-Ocean), led by Professor Doctor Don Fernando Mendez Incera, of the Department of Water Sciences and Techniques and the Environment of the University of Cantabria.

3.- Base tender budget and credit of guarantee.

The base tender budget, excluding taxes, is 166,000 USD. The credit which guarantees it is the Convention:
IMPACT FORECASTING CONSULTANT´S SERVICES FOR THE PACIFIC COMMUNITY.

The type of budget will that of a specified maximum, including maintenance for 15 months, travel, labor,material and any other necessary and justified expense, borne by the supplier, with direct and indirect costs and other possible expenses calculated for its determination:

The estimated value of the contract is 137,372 euros (with the latest official exchange rate of the Bank of Spain – 18/02/2021).

4.- The contract is NOT subject to harmonized regulation.

5.- Business or Professional qualifications required for the execution of the contract.

For the accreditation of the eligibility conditions, a declaration of responsibility will be required in which it is guaranteed that the participating companies have full capacity to act, are not subject to any prohibition to be contracted, and accredit their economic, financial and technical solvency.

6.- The requested economic and financial solvency must be proportional to the object of the contract, and should not, in any case, pose an obstacle to the participation of small and medium-sized companies, the provision of the declaration of responsibility being sufficient.

7.- The award procedure chosen is open.

8.- Objective criteria of the contract award.

The main award criteria will be the quality of the service, experience in previous works and especially, in the countries of the South Pacific, related to flood risks, oceanographic monitoring and development of operational systems of oceanographic variables (waves and tsunamis). The tenderer will be selected according to the score obtained, between 0 and 100 points, in accordance with the following scales.

1. Technical aspects: 90 points
2. Economic proposal: 10 points

9.- Technical documentation to be presented in relation to the objective criteria of the contract award contract:

In this stage of the procedure, the tenderers may provide their experience accredited by the usual means, such as the elaboration of a list of activities performed by the company in the last five years related withthe object of the present tender.

10.- Admissibility of variants.

This is appropriate, on condition that a link to the object of the contract is accredited.11.- Electronic

means.

The presentation of tenders must be made by electronic means to the email fltqadmon@unican.es

12.- Definitive guarantee.

This is NOT appropriate in accordance with the circumstances of the tender, and as the non-fulfillment of the terms of the will lead to the termination of the payment procedure and the contract itself.

13.- Complementary guarantee.

This is NOT appropriate in accordance with the circumstances of the tender.14.- Delivery

of results of the service and surveillance powers of the FLTQ.

The method for exercising surveillance and verification by the FLTQ will be through the dispensation of the certification of receipt with the official approval issued by the technician responsible for the GEO- OCEAN Research Group at UC, from the Department of Water Sciences and Techniques and the Environment of the University of Cantabria requesting the Service.

15.- Period of execution. Total of 15 months. Partial receptions: These ARE allowed.

It is appropriate to extend the contract on condition that notice is given at least one month prior to the completion of the period of duration of the contract.

16.- As a special condition of the execution of the contract, any contribution which serves to protect the environment will be positively evaluated.

17.- Penalties. No specific penalties are established. The legal contractual guarantee will suffice.18.- No

modifications to the contract are projected, except for unforeseeable circumstances.

19.- Subcontracting. The contractor may agree with third parties the partial undertaking of the service, under obligation to report this to the FLTQ which must approve it.

20.- Regime and form of payments.

In return for the development of the work, the FLTQ undertakes to pay the contractor the corresponding sum. This payment will be made in accordance with the following conditions:

- 20 % at the end of Month 1
- 20% at the end of Month 4
- 20% at the end of Month 7
- 20% at the end of Month 10

20% at the end of the work – Month 15 – and after the delivery of the System and Final Report21.- A review of

prices will be allowed in exceptional circumstances duly justified.

22.- Information on the contract whose confidential nature must be respected by the contractor.

In this section, indication will be made of the information relative to the contract which is considered confidential.

23.- Period of guarantee. The Contracting Board of the FLTQ does not consider appropriate the requirement of a period of special additional guarantee in this contract procedure.

CHAPTER II. GENERAL PROVISIONS

Clause 2. Legal regime.

The present contract has a private law status. The parties are expressly subject to the provisions of this Schedule of specifications and the corresponding specific technical prescriptions. For matters not
provided for in the specifications, the contract will be governed by Law 9/2017, of November 8, on Public Sector Contracts:

Clause 3. Object of contract.

The object of the contract established in this schedule is the service described in Clause 1:

- Assistance with the tsunami driven inundation forecast system for Tonga and Samoa
- Preparing material and participating in agreed training and capacity building activities
- Training on deployment of wave buoys
- Assistance with integration of forecast system to the Meteorological services CLiDEsc Portal

Clause 4. Base tender budget and contract price.

The base tender budget, excluding taxes, is: 137,500 euros.

Clause 5. Contractor profile.

Access to the contractor profile of the contracting body will be made through the Contracting Portal of the FLTQ, at the following Internet address (URL):

https://web.unican.es/fltq/perfil-del-contratante

CHAPTER III. TENDER

Clause 6. Capacity to contract and criteria for selection of companies

The award of this contract is open to any Spanish or foreign company that can accredit their economic, financial and technical solvency, with their business and professional capacity accredited by means of a declaration of responsibility.

Clause 7. Award procedure.

The contract will be awarded by means of an open procedure with a plurality of criteria.

Clause 8. Objective award criteria.

The objective criteria which are to serve as the basis for the contract award are those set forth, with their corresponding weighting, in Section 8 of Clause 1.

Clause 9. Presentation of proposals.

Proposals are to be presented in PDF format, in the email address of the Leonardo Torres Quevedo Foundation: fltqadmon@unican.es

The deadline for the submission of the documentation is Wednesday, March 10, 2021 at 12:00 a.m., UTM+1.

Clause 10. Electronic means.

The use of electronic, computer and telematic means and devices in the presentation of proposals is compulsory. Committing any misrepresentation in providing any false data relative to the company's capacity or solvency is cause for the prohibition of contracting.

Clause 11. Form and content of proposals.

The proposals are to be presented either in English or in Spanish, in TWO PDF FILES, which will include the following documents:

1. PDF N.º 1. "ADMINISTRATIVE DOCUMENTATION", which must include all of the company identification documents,

declaration of responsibility and technical experience.

2. PDF Nº 2. “ECONOMIC PROPOSAL”.

Clause 12. Opening of proposals.

Once the deadline for receiving offers has transpired, the Contracting Board will be constituted in order to proceed with the opening of the incoming emails, with the requested PDFs, and the received offers willbe evaluated. Minutes will be drawn up with the winning bid, and this will be communicated to the winning company, and published on the FLTQ WEBSITE, in the contractor profile.

Clause 13. Definitive guarantee.

The contracting board waives the winning bidder from the obligation to provide a guarantee, in keeping with the concurrent circumstances of the tender.

Clause 14.- Accreditation of capacity to contract and contract award process. Waiver or withdrawal.

The Contracting Board will consult by electronic means that the bidder is up to date in complying with the legal obligations. Participation in the tender authorizes the FLTQ to verify the veracity of the documentation provided.

The award proposal of the Contracting Board does not create any rights in favor of the bidding company,who will not acquire these, with respect to the FLTQ, while the contract has not been formalized.

CHAPTER IV. AWARD AND FORMALIZATION

Clause 15. Contract award.

Once the documentation has been presented, in a time no longer than 5 calendar days, the contract will be awarded to the bidder proposed as the awardee.

Clause 16. Finalization and formalization of contract.

The contract will be finalized by means of the written formalization of the same.CHAPTER V.

EXECUTION OF THE CONTRACT

Clause 17. Principle of risk and venture.

The execution of the contract will be undertaken at the risk and venture of the contractor. The selected businessman must be in possession of a Civil Liability Insurance that guarantees his work, exempting the
F.L.T.Q. from any liability for his actions.

Clause 18. Subjection to schedules of specific administrative clauses and technical specifications.

The contract will be executed subject to the clauses of the present Schedule of specifications, to those of the specific technical prescriptions and in accordance with the instructions given by the FLTQ to the contractor for their interpretation through, where appropriate, the person responsible for the contract. The contractor will be responsible for the quality of the service provided, as well as for the consequences that may be deduced for the FLTQ or for third parties due to omissions, errors or inappropriate methodsin the execution of the contract.

Clause 19. Management and supervision of service and supply.

The FLTQ has the authority to inspect and to be informed of the development of the provision of services, object of the contract, and can order or perform itself when appropriate analyses, proofs or tests to be used, establish quality control systems and draw up as many provisions as it considers appropriate for the correct fulfillment of the contract.

Clause 20. Period of execution and extension of contract.

The total term of the contract and partial terms, if any, are set out in section 15 of Clause 1, the place of delivery or provision of the service being the one detailed in section 14 of the same Clause.

The contract will be executed during the period established in the aforementioned section 15 of Clause 1, or in the period determined in the award of the contract, the partial terms, where appropriate, being those established in said section or those that the contractor might offer should these constitute an improvement on the former.

The calculation of the period for the execution of the contract will begin on the day following the formalization of the contract, in accordance with section 15 of Clause 1. The contractor is obliged to fulfill the contract within the total period established for the execution of the same, as well as the partial deadlines indicated for its successive execution.

One or more extensions may be admitted, provided that the characteristics of the contract remain unchanged during the period of their duration. In no case may the extension take place by the tacit consent of the parties.

Clause 21. Penalties for non-fulfillment of contractual obligations.

When the contractor, for causes attributable to the same, has incurred in a delay with respect to the fulfillment of the total period or of the partial periods, should these have been established, for which this will be verified in section 15 of Clause 1, the FLTQ may, on examining the circumstances of the case, opt for the termination of the contract without compensation.

Clause 22. Liability of contractor for damages.

The contractor will be responsible for all direct and indirect damages caused to third parties as a result of the operations required for the execution of the contract. In cases of partial non-compliance or defective compliance or a delay in execution for which no penalty is foreseen, these will demand compensation from the contractor for damages.

Clause 23. Modification of contract.

The Contracting Board may, once the contract is finalized and for reasons of public interest, order the appropriate modifications, duly justifying them in the report.

Clause 24. Suspension of the contract.

The FLTQ may, for reasons of public interest, order the suspension of the execution of the contract. Similarly, the suspension of the fulfillment of the contract on the part of the contractor may be determined if there were a delay in the payment of over four months.

Clause 25. Assignment of contract.

The rights and obligations emerging from the present contract may be assigned by the awardee to a third party, on condition that this is agreed by both parties.

Clause 26. Subcontracting.

The successful bidder of the contract may agree with third parties the partial undertaking of the same. He must communicate by email, to the FLTQ Contracting Board, all of the modifications made. This will not alter the sole responsibility of the main contractor.

The subcontractors will not in any case have any direct relation with the contracting FLTQ for the obligations contracted with them by the contractor, as a consequence of the execution of the main contract and the subcontracts.

CHAPTER VI. RIGHTS AND OBLIGATIONS OF THE CONTRACTOR

Clause 27. Payment of contract price.

In keeping with the agreement made in the contract, the contractor is entitled to receive the payment ofthe price of the services duly delivered and formally received by the FLTQ. In Section 20 of Clause 1, the form and conditions of payment for this contract are stipulated.

Clause 28. Review of prices.

The review of prices will be as specified in Section 21 of Clause 1.

Clause 29. Obligations, expenses and taxes to be demanded of contractor.

All expenses and taxes for the formalization of the contract, in the event of elevation to public deed, are borne by the contractor as well as however many licenses, authorizations and permits are required in order to correctly execute and deliver the agreed service. Likewise, he will be obliged to meet all the expenses that the company must pay for the fulfillment of the contract, such as general, financial, insurance, transport and travel, materials, facilities, fees of the personnel under his charge, verification and testing, rates and all kinds of taxes: VAT, any tax that may be incurred by the performance of the activity and any others that might arise from the execution of the contract, during the term of the contract, without these being considered as an independent item.

It is expressly stated that the costs of delivering the services that are the object of the contract to the place indicated in section 14 of Clause 1 will be borne by the contractor.

The contractor will be under the obligation to present the invoice or invoices corresponding to the execution of the object of the contract, in the aforementioned email.

Clause 30. Contracting measures with companies who are obliged to have workers with disabilities among their staff.

When the contractor company is obliged by the legislation, the declaration of responsibility will be made.

Clause 31. Labor, social and environmental obligations.

During the execution of the contract, the contractor must comply with the obligations applicable in environmental, social or labor matters and in Occupational Risk Prevention, regulated by the provisions of international environmental, social and labor law, that bind the State to which the contractor belongs.

The contractor must respect the working conditions established in the sectorial Collective Agreements that are applicable in his State. Likewise, he undertakes to certify compliance with the aforementioned obligation before the contracting body, if required to do so, at any time during the term of the contract.

CHAPTER VII. TERMINATION OF CONTRACT

Clause 32. Fulfillment of contract and reception of service.

The contract will be understood to have been fulfilled by the contractor when, after the full term of the contract has transpired, it has been carried out in accordance with the terms of the same and, to the satisfaction of the FLTQ, with its object in its entirety.

The contractor will not be entitled to compensation for losses, harm or damages incurred in the provision of the service that is the object of the contract, prior to its delivery to the FLTQ.

Within the month following the fulfillment of the object of the contract, the service will be received through a formal act.

If the service is provided in accordance with the technical specifications, the personnel designated by the FLTQ will consider it received, drawing up the corresponding certificate, which must be signed by the participants upon reception, the period of guarantee beginning at that moment.

If the service is not provided in the state of being received, this will be recorded in the reception act andprecise instructions will be given to the contractor so that the defects observed are corrected or a new supply of the service is undertaken in accordance with that agreed in the contract.

Clause 33. Settlement of contract.

Within a period of sixty days, counting from the date of reception or in accordance with the contract, the FLTQ must approve and notify the contractor of the settlement of the contract and pay him, in its case, the resulting sum.

Clause 34. Period of guarantee.

The period of guarantee will begin from the date of reception and will be that established in Section 23 of Clause 1.

Clause 35. Flaws or defects during period of guarantee.

If, during the period of guarantee, the existence of faults or defects in the provision of the service is established, the FLTQ will have the right to demand their repair from the contractor, should this suffice. In any case, during the period of guarantee, the contractor will have the right to know and to be heard about the application given to the service provided.

Clause 36. Return and cancellation of the definitive guarantee.

The posting of bonds is not required, in accordance with the circumstances of the present tender.

Clause 37. Termination of the contract.

The termination of the contract will be agreed by the Contracting Board ex officio or at the request of the contractor. In the cases of termination of the contract due to non-fulfillment on the part of the contractor, the FLTQ must be compensated for the damages caused. The following are causes for termination of thecontract:

1. Failure to comply with the conditions established in terms of subcontracting,
2. The breach by the contractor of the essential obligations of the contract indicated in these specifications.

Clause 38. Prerogatives of the FLTQ, review of decisions and competent courts.

In keeping with the provisions of the second clause of the Schedule, this contract is a private one. The contracting board has the power to resolve any matters that might arise during the surveillance of the same in terms of its interpretation, modification, effects and termination, within the limits and subject to the requirements specified in the Public Sector Contracts Law. Participation in this tender implies the submission of the contractor to the Courts of Cantabria.

NIWA
Taihoro Nukurangi

ASSISTANCE IN DEVELOPING AN OPEN-SOURCE TSUNAMI INUNDATION FORECAST SYSTEM FOR TONGA ANDSAMOA

Administrative Documentation

Prepared for Fundación Leonardo Torres QuevedoFebruary 2021

Climate, Freshwater & Ocean Science

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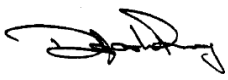
NIWA Proposal No: UCS20501
NIWA Project: UCS20501

Revision	Description	Date
Version 1.0	Final Administration Documentation Proposal	9 March 2021

Quality Assurance Statement		
	Reviewed by:	Doug Ramsay
	Formatting checked by:	Rachel Wright
	Approved for release by:	Bryce Cooper

Contents

1 Introduction

1.1 Background

The Fundación Leonardo Torres Quevedo of the University of Cantabria, a non-profit organisation, has been contracted by the Pacific Community as part of the Pacific Resilience Program (PREP) funded by the World Bank and implemented at the regional and national level by the Pacific Community, Pacific Island Forum Secretariat and the Governments of Samoa, Tonga, Marshall Islandsand Vanuatu. The GeoOcean Engineering Group (GeoOcean) from the Department of Sciences and Technologies of Water and Environment of Universidad de Cantabria is developing a demonstration forecast system for Tonga and Samoa that accounts for different hazards such as: swell driven inundation, tropical cyclone driven inundation, earthquake-based tsunami driven inundation, and a seasonal inundation outlook (for swell and tropical cyclones). The core of the methodology used by the GeoOcean group for the operationalization of the forecast systems and risk assessments is a hybrid downscaling approach. Hybrid downscaling combines numerical models (dynamical downscaling) with mathematical tools (statistical downscaling) and is known as metamodel.

The Fundación Leonardo Torres Quevedo of the University of Cantabria, GeoOcean group requires assistance in developing an open source tsunami driven inundation forecast system for Tonga and Samoa and technical assistance to support wave buoy deployment and integration of model outputin to existing delivery systems.

1.1.1 About NIWA

The National Institute of Water and Atmospheric Research Ltd, (NIWA) is one of the Southern Hemisphere's leading providers of scientific research, knowledge and consultancy services concerning air and water resources. Established in 1992, NIWA has delivered innovative and appropriate solutions to complex water and atmospheric-related management and development problems ever since. NIWA is a New Zealand Crown Research Institute and is a duly incorporated company with all shares owned by the New Zealand Government. The organisation specialises in:

- Freshwater hydrology and hydraulics
- Aquatic resources and environments (with a focus on surface freshwaters and coastal environments)
- Oceans
- Freshwater and marine fisheries
- Aquaculture
- Climate and atmosphere
- Climate, weather and coastal hazards and risk
- Aquatic and atmospheric-based energy resources
- Aquatic biodiversity and biosecurity

NIWA employs around 700 personnel, including scientists, engineers and support staff. The organisation conducts over 1,500 projects each year. Our clients include New Zealand and overseas

governments, international development agencies, regional councils, territorial authorities, industries such as energy, fisheries, forestry, dairy, horticulture, and agriculture, port authorities, andoil companies and consulting engineers. NIWA has carried out applied science and consultancy services for clients in many overseas countries.

NIWA has extensive experience in conducting development projects throughout the Pacific and assisting island states with environmental issues. NIWA staff fully appreciate the issues and responsibilities required in developing appropriate solutions in such environments. We currently have active hydro-meteorological installation projects in Samoa, Fiji, Solomon Islands, Vanuatu, Cook Islands, Kiribati and PNG, and have installed operational flood warning systems in Samoa, Fiji and PNG.

Much of this experience has been developed through our long history of working collaboratively with both in-country agencies and regional organisations in the areas of natural hazard and disaster risk management, weather, climate and hydrological monitoring, early warning assessment and applications.

Our approach with all our work in the Pacific is to ensure that we are a "long term" organisation through building and maintaining enduring relationships with the Pacific Island organisations and personnel that we work with. In addition, NIWA has access to over 700 scientists and technical staff,covering many environmental science disciplines.

The most appropriate teams are assembled depending on the requirements of each project, with thestaff used on any project well experienced in conducting the work required. NIWA can provide sufficient key staff and back-up personnel, to ensure that each project is completed within the required timeframes and to the required standards. For this particular project, NIWA does not envisage engaging any subcontractors to support the work.

1.1.2 Tsunami science

Natural hazard risk reduction and assessment is a core part of NIWA's activities both in New Zealand and the wider Pacific region. The natural hazards and risk expertise within NIWA includes weather, climate, flood and coastal and tsunami-related hazards and risk assessment, with a core team of around 30 staff.

NIWA is currently involved in complex tsunami modelling projects in New Zealand and the Pacific region, and has been engaged in the delivery of similar services over the past few decades.

In 2020 and 2021, NIWA conducted tsunami research in Samoa leading to 3 research articles lead by NIWA in collaboration with partners in Samoa. The first article reanalyses the 2009 South Pacific Tsunami (Figure 1-1) (Bosserelle et al. 2020), demonstrating that the full complexity of the fault rupture and tsunami initiation is yet to be fully resolved. Williams et al. 2020 reviewed the tsunami deposit in Samoa predating 2009 and Paulik et al 2021 analyse the change in tsunami risk associated with relocation and redevelopment following the 2009 South Pacific Tsunami in Samoa.

NIWA is also currently assisting the Pacific Community (SPC) in producing tsunami simulation andcomparing tsunami inundation methodology using Samoa Islands as a case study to produce guidelines for developing tsunami evacuation zones.

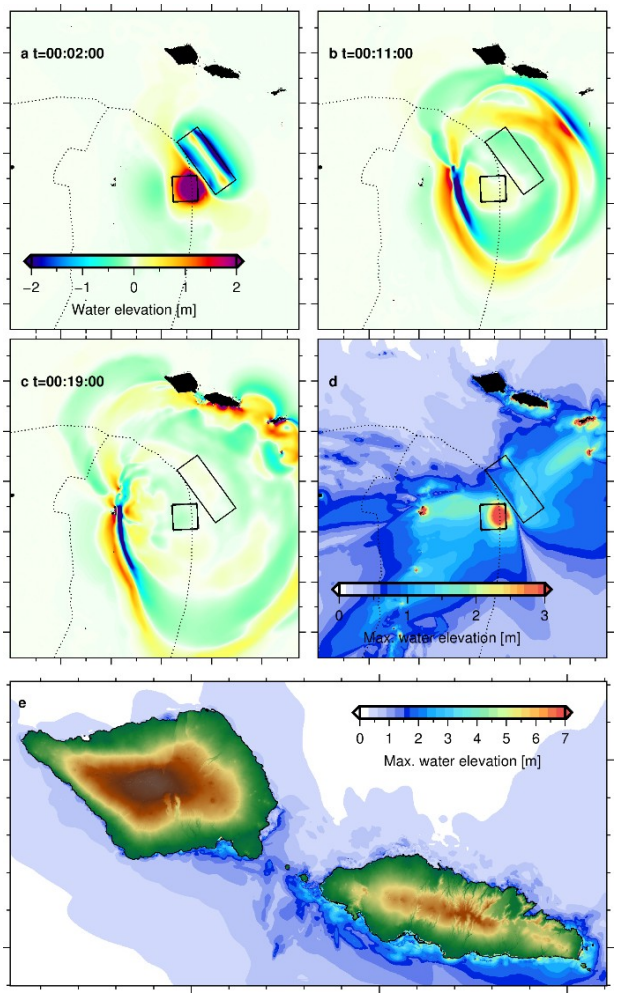


Figure 1-1: 2009 Pacific Tsunami Reanalysis produced by Bosserelle et al. 2020. .

NIWA, also, recently completed a tsunami coastal impacts study at Omaha Beach in the northern Auckland region. The study applied a spatio-temporal loss model to quantify the changes in direct economic losses to residential buildings from tsunami hazards over a 20-year period in Omaha Beach, New Zealand. (Paulik et al. 2019)

In July 2018, NIWA in partnership with eCoast Ltd completed a set of Level-3 tsunami inundation and evacuation zones maps for the whole of Gisborne District Council. This work included a thorough investigation of the tsunami potential of the southern section of the Tonga-Kermedec trench. (Borrero and Bosserelle 2018)

1.1.3 Delivery, installation of meteorological and coastal monitoring/forecasting earlywarning system

NIWA currently has active hydro-meteorological installation projects in Samoa, Fiji, Solomon Islands, Vanuatu, Cook Islands, Kiribati and PNG, and have recently installed operational flood warning systems in Samoa, Fiji and PNG.

NIWA is currently working on a Flood Monitoring and Early Warning System development in the Vaisigano Catchment, Samoa using the CliDEsc Portal to deliver forecast products.

In 2018—2019 NIWA completed the, ADB funded, Tonga meteorological and coastal monitoring system development. Involving the design, procurement and implementation of a meteorological and coastal monitoring/forecasting system for Tonga. This included close consultation and liaison with the Tonga Meteorological Service (TMS) as well as TMS maritime information stakeholders. Theproject included the installation/deployment of 21 weather stations, 2 permanent tide gauges, 12 temporary tide gauges and 8 temporary wave gauges (Figure 1-2). The project also developed and operationalised the pilot CliDEsc Portal to deliver waves and tide forecast products on the same platform as climate products derived from weather station data.

In 2018, NIWA Completed the UNDP funded Bumbu River Catchment Flood Early Warning System, Papua New Guinea. This involved coordinating the design and installation of flood monitoring equipment in the Bumbu catchment, development of flood monitoring and warning standard operating procedures for PNG Meteorological and Hydrological services staff including capability strengthening and training.

In 2018, NIWA completed a WMO funded Coastal Inundation Alert Support System for the Nadi Floodplain. The project demonstrated the strength of simple interface for tide and flood forecast products that guided the type of information tools displayed on to the CliDEsc Portal for Samoa.

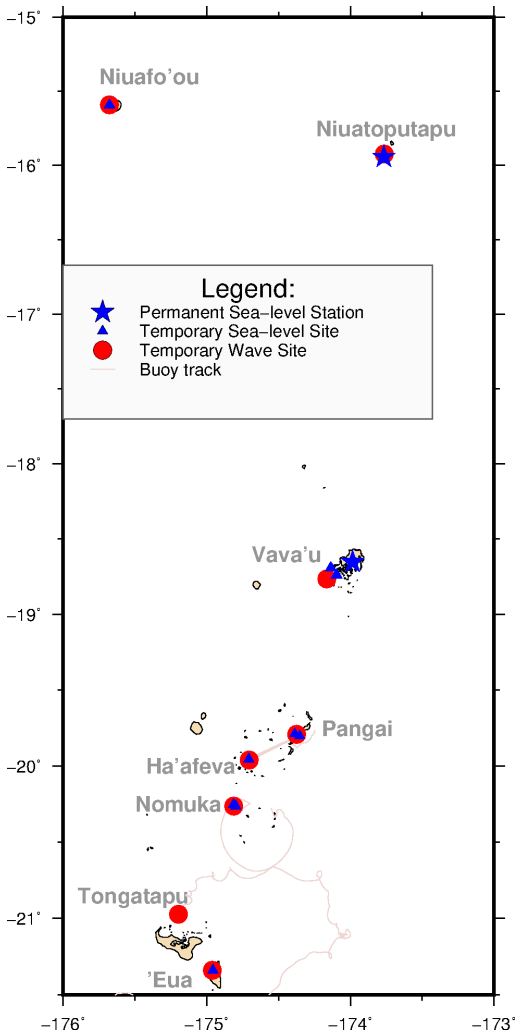


Figure 1-2: Summary of wave and water level sensors installed in Tonga. 21 weather stations were also installed during the same project but are not shown on the map.

1.1.4 CliDEsc Portal

NIWA has been developing the CliDEsc Portal for displaying climate and forecast products. This is an web-portal, currently operational in Tonga as a pilot and in development for Samoa, that provides user-specific dashboards of user-defined products and outputs from any source (real time data, satellite data, global model output, locally run models or scripts etc)(Figure 1-3). In Tonga the portal is being used to serve a wide variety of near-time climate-related products for different sectors, near-time sea-level and temperature information, and high-resolution wave forecast model outputs and warnings for inter-island shipping and ferry services. The portal is currently being developed further and will be soon operational in Samoa as part of the PREP-funded flood impact warning system project: Supply and installation of a flood early warning system and supply of monitoring equipment for the Vaisigano catchment. In Samoa the portal will incorporate real time weather, hydrological and tide data, numerical weather prediction output, hydrological model output and risk and impact information (damage levels to buildings, roads impacted, population displaced etc). Use of the portal will ensure a consistency of operational platform for the Meteorological Services in both countries and enables them to deliver specific forecast outputs and dashboard displays directly to key responseagencies such as the National Disaster Management Offices.

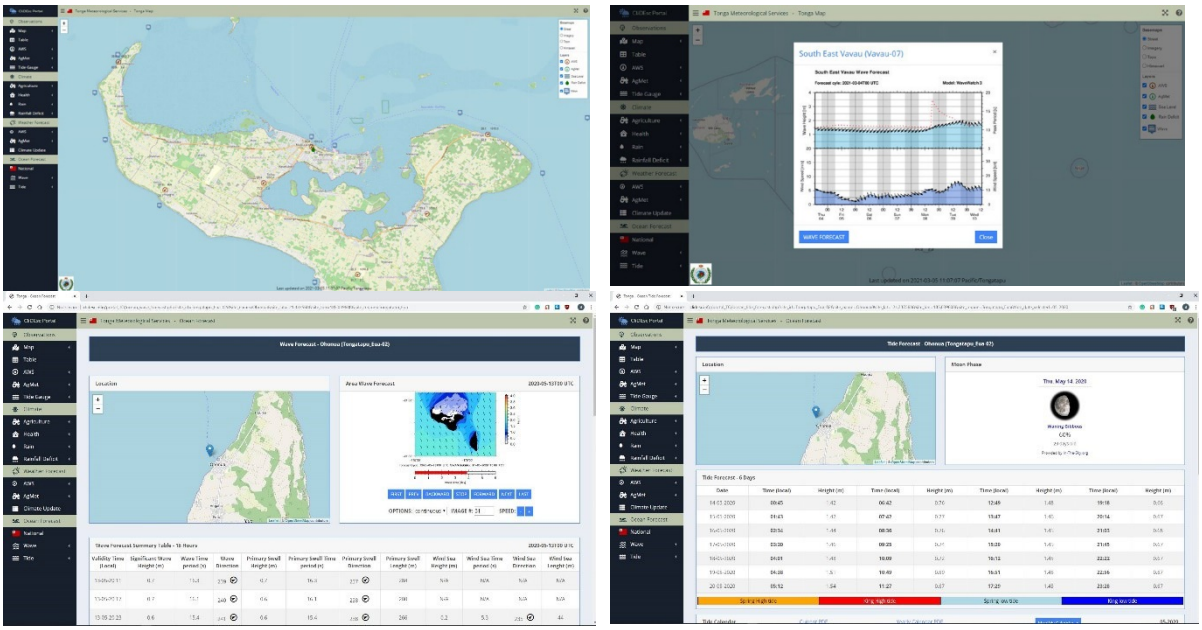


Figure 1-3: Current screenshots from various dashboard displays of the pilot CliDEsc portal operational inTonga Meteorological Service.

1.2 Our understanding of your requirements

GeoOcean group requires assistance in developing an open source tsunami driven inundation forecast system for Tonga and Samoa and with deployment of ocean observation buoys. In particular, the GeoOcean group is looking for assistance from companies with experience in:

1. Developing an open-source tsunami driven inundation forecast system using the metamodel approach
2. Preparing Technical and training material

3. Facilitate the integration of forecasting products to the Samoa and Tonga CliDesc portals

4. Assisting with deployment of ocean observation buoys

1.3 Scope of the project

NIWA's proposal is to assist the GeoOcean team in development of forecast system for coastal hazard in Samoa and Tonga. The scope of the project is to develop an open-source tsunami inundation forecast system, facilitate the integration of selected products (tsunami and others) fromthe forecast system in the CliDEsc Portal. Assist with deployment of wave buoys in Samoa and Tongaby remotely training local teams and preparing technical and training material for activities where NIWA is involved. And attend/participate in project meetings with clients and stakeholders.

The proposed project does not include assistance with development of other components of the PREP project (i.e., other than listed above). In particular, the development of non-tsunami related forecast products outside of modification of existing products to facilitate integration in the CliDEscPortal.

This proposed project also does not include any boating activities because the actual buoy deployment will be conducted by local teams. It is also expected that the wave buoys and main partsof the mooring will be purchased directly by FLTQ/GeoOcean team.

1.4 Purpose

This proposal is provided solely for the purpose of demonstrating to you NIWA's ability to provide the services and for no other purpose. The proposal may not be used by or distributed to a third party for any other purpose without NIWA's prior written consent.

2 Methods

2.1 Task 1: Develop a Tsunami driven inundation forecast system for Tongaand Samoa

The GeoOcean team requires assistance to develop an open-source tsunami inundation forecast system using a metamodel approach.

An open-source tsunami inundation forecast will require the use of open-source numerical model suitable for simulating tsunami at relevant scales for tsunami generation, propagation and inundation. In addition, a good understanding of the mechanisms of subduction zones surrounding the Pacific basin will be required with an in-depth understanding of the fault complexity on the Tonga-Kermadec Trench, and in particular at the North end of the trench just North of Tonga and south of Samoa. Building the early warning system for tsunami in Samoa and Tonga also requires in- depth understanding of the warning protocols of regional and local agencies (e.g Pacific Tsunami Warning Centre).

NIWA team has an extensive experience in studying the tsunami risk from the Pacific Basin and has been involved in numerous studies of tsunami hazard in New Zealand and in the Pacific Islands. NIWA has also developed an open-source model "*BG-Flood*" that is capable of simulating tsunami wave generation, propagation and inundation at the Pacific, regional and local scale using an adaptive mesh (Bosserelle et al. 2020). The model is unique in that it is capable to use Graphical

Processing Unit (GPU) of computers to significantly reduce computational times and thus ideal for running the many scenarios required to train a tsunami inundation metamodel.

BG-Flood will be used to estimate tsunami generated from earthquakes. Historical tsunamis in Samoa and Tonga have been caused by both earthquakes and volcanoes. However, the research on tsunami generation by volcanic collapse and eruption is still in its infancy. Therefore, only earthquake tsunami sources will be considered within this proposal. For far-field tsunami (i.e., generated away from Samoa and the Tonga Kermadec trench) faults characteristics from the SIFT or PTHA will be used to estimate initial co-seismic deformation from unit fault blocks of 100 km by 50 km along all the subduction zones of the Pacific Basin. BG-Flood will be used to propagate tsunami waves to Tonga/Samoa local model and train the hybrid downscaling. For regional and nearfield tsunami, a more detailed analysis may be required to capture complex rupture mechanisms such as the double/triple earthquake that caused the 2009 and 2021 tsunamis. To achieve this NIWA will build on its ongoing research in collaboration with MNRE Samoa (Disaster Management Office) as well as insight gained as members of the UNESCO ICG-PTWS WG1 Scientific Experts Meeting (Scientific meeting of experts to understand tsunami sources, hazards, risk and uncertainties associated with the Tonga-Kermadec Subduction Zone).

For tsunamis inundation simulation of far-field tsunami, the hybrid downscaling to the offshore boundary of the inundation model can be made as simple as a linear scaling of the tsunami height relative to the fault slip amount and a linear superposition of the contribution of different fault segments involved (as in the COMMIT tool). For local tsunami, the co-seismic vertical displacement needs to also be considered too, so a separate metamodel will be developed for nearfield tsunami forecast. Historical events such as the 2009 tsunami, the 2011 Tohoku tsunami (which caused minor, localised inundation in Samoa) and the recent 2021 minor tsunami will provide suitable tide gauges and runup data to validate the model and the metamodel. The metamodel of inundation at 10m resolution based on offshore tsunami characteristics will be completed for both islands of Samoa andTongatapu.

2.2 *Task 2: Prepare material and participate (remotely) in training andcapacity building activities*

In order for Samoa and Tonga meteorological service staff and other stakeholder to understand and become expert user of the forecasting system, NIWA team will produce technical material, documentation and capacity building material for the Tsunami meta-model, buoy deployment and CLiDEsc Portal integration and other work where NIWA is involved. While Covid-19 restriction are likely to prevent in-person visits, NIWA is ready to use alternative means that will suits Samoa and Tonga stakeholder best. NIWA team selected for this project has previously work with key stakeholders. The detailed and the type of training material produced (i.e., wiki, video, live stream) will depend on consultation at the project early stage and adapted depending on stakeholder feedback in the course of the project. Material to be prepared include but may not be limited to:

- Technical reports
- Wikis
- Live (online) presentations and walkthrough
- Video and or illustrated tutorials

- Draft/template of Standard Operating Procedures

2.3 Task 3: Assist with integration of forecast system to the Meteorologicalservices CLiDEsc Portal

The forecast system for Tonga and Samoa developed by the GeoOcean will produce Jupyter notebooks that Samoa and Tonga forecasters will be able to manipulate and modify when investigating particular coastal hazard. Some of the products from the notebooks can be automatedto simplify the day-to-day workflow of forecasters. The automation and ingestion of these forecasting products will be integrated in the already operational CliDEsc Portal. This is a web-portal developed by NIWA, currently operational in Tonga and Samoa as a pilot, that enables user-specific dashboards to be easily developed of user defined products and outputs from any source (real time data, satellite data, global model output, locally run models or scripts etc). Use of the portal will ensure a consistency of operational platform for the Meteorological Services in both countries and enables them to deliver specific forecast outputs and dashboard displays directly to key response agencies such as the National Disaster Management Offices.

NIWA will facilitate the integration of selected forecast product to the CliDEsc Portal. This will include:

- Consultation with GeoOcean team and Samoa and Tonga agencies to select product that can be automated
- Converting Jupyter notebook to Python script that can be automatically launched by CliDEsc
- Designing a layout and ingestion of product for display on the portal
- Trial operational use of the portal with the countries and adapt based on feedback from them.

The integration of the forecast products display on CliDEsc portal is critical for facilitate the operational forecaster workflow but does not substitute the use of the Jupyter notebooks for morein-depth analysis. This activity will depend on draft forecast products being shared with forecastersand NIWA during development stages so that the forecaster can express which product they need/want automated and the NIWA team can adapt/prepare the layout of forecast page of the CliDEsc portal.

2.4 Task 4: Training on deployment of wave buoys

NIWA has a wide experience with deployment of met and ocean equipment in the Pacific region. In particular NIWA has deployed 9 wave buoys in Tonga main and outer islands and understands the challenges of preparing mooring, deployment and maintenance in Pacific island countries. Our team have also managed to proceed with the installation of flood monitoring instrumentation in Samoa after COVID-19 prevented NIWA technician to travel to the island. NIWA staff with local knowledge and experience in installing meteorological and ocean monitoring system in Samoa and Tonga will assist with the preparation, deployment and establishing standard operating procedure for buoy maintenance. The tasks will be to (remotely) assemble a local wave buoy deployment team and support the team to:

- select suitable buoy deployment site

- prepare application to any permits and notifications associated with the deployment
- establishment of partnership, drafting SOP for developing a buoy maintenance plan

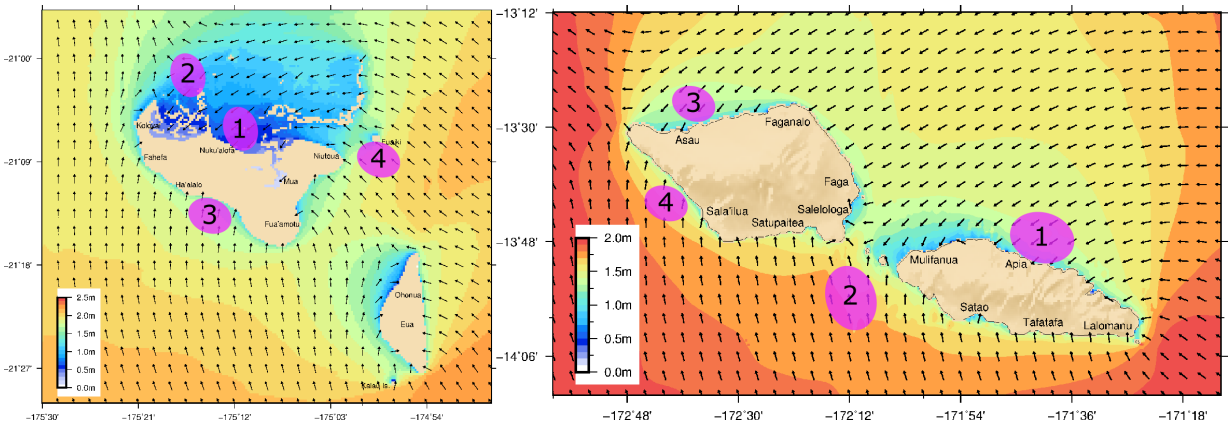


Figure 2-1: Suggested buoy location for Tongatapu (Left) and Samoa (right). Background shading shows the mean annual significant wave height and arrows show the mean wave direction (Source: Bosserelle et al. 2015).

A senior NIWA field technician will prepare the buoy and mooring from New Zealand and ship the buoys and moorings. Of the four buoys, one buoy will be dispatch "ready-to-deploy" while other buoys will be sent as kit to be assembled by the local team. The local deployment team will then receive online trainings (Video and/or online material). After reception of the buoy in each country, Live meeting will be used to support the online training on how the wave buoy operates, how the mooring configuration works, run through mooring and deployment process and replacement and the development of a routine maintenance program and assist with drafting of standard operating procedures (SOP) related to wave buoy instrumentation (including for example. the safe handling of mooring/recovery procedure).

While this is not NIWA's traditional buoy deployment procedure, The remote deployment training is also being trialled by SPC and material produced by SPC for wave buoy deployment in Tuvalu will be adapted for use in Samoa and Tonga.

2.5 *Our understanding of your contributions to the project*

While NIWA will often communicate to Samoa and Tonga in the course of the project, it is expected that FLTQ/GeoOcean team will organise/ facilitate high-level meeting with clients and stakeholder, support/coordinate with NIWA in organising training to best avoid duplication. FLTQ/GeoOcean is also expected to share with NIWA the ode repository of Jupyter notebooks and share with NIWA any data relevant.

FLTQ/GeoOcean is expected to purchase and ship all wave buoys and mooring to NIWA.

Guidance from the GeoOcean team will be required so the NIWA tsunami metamodel is consistent with metamodel produced by GeoOcean for other coastal hazards and that forecast products have a similar feel.

3 What we will deliver

Output of the proposed work is summarised, below, for each task.

3.1 Task 1: Tsunami driven inundation forecast system outputs

For tsunami driven inundation forecast system the principal output is an operational forecast systemfor tsunami inundation in Samoa and Tonga. This includes:

- Source code (Jupyter Notebook) of an operational forecast system for tsunami inundation model for Tonga and Samoa based on open source solution
- Operational manual and validation summary report of the tsunami model and metamodel using historical tide gauge data and existing run-up information (ex. 2009 event).
- Summary analysis report of all possible tsunamigenic earthquake scenarios relevant for Tonga and Samoa
- Database of synthetic tsunami events that can affect Tonga and Samoa
- Trained meta-models (near-field and far-field) for the forecast system

3.2 Task 2: Training and Capacity building material

- Report on operationalization procedure of tsunami driven inundation to produce a tsunami driven inundation forecast
- Online manual on tsunami inundation forecast operationalization procedure and training material
- Live (remote) presentation of the tsunami forecasting system
- Live (remote) presentation of CliDEsc Portal integration
- Video and writing tutorials for tsunami inundation forecast and CliDEsc integration/use
- Draft/template standard operating procedure

3.3 Task 3: Wave buoy deployment outputs

- Written and Video tutorial on wave buoy deployment procedures
- Assembled and trained local teams
- One wave buoys ready to deploy. Three wave buoy deployment kits

3.4 Task 4: CliDEsc Portal outputs

- Collection of automatic forecast products selected
- CliDEsc Portal panel designed for selected products
- Python script automatically run by CliDEsc and displayed on the Portal

4 Timing and progress reports

Provided that this proposal is accepted and a contract signed by both parties by 10 April 2021:

- Tsunami driven inundation forecast system For Tonga and Samoa developed by November 2021
- Live training sessions are expected in September 2021 and February 2022
- Forecast products are integrated and displayed on Clidesc portal by March 2022
- NIWA will keep The Fundación Leonardo Torres Quevedo and GeoOcean teaminformed of progress by email contact and regular team meetings.
- NIWA anticipates being able to complete the project and provide The Fundación Leonardo Torres Quevedo with the project deliverables by March 2022. If this cannot be achieved for whatever reason, NIWA will discuss with you the reasons for this and work with you to agree an appropriate adjusted timeframe.

5 The project team and responsibilities

The team selected for this project has deep connection with the Pacific Met and hazard community and currently involved in Project in Tonga and Samoa.

The **Project Director** will be **Doug Ramsay** who will maintain a higher-level overview of this project to ensure that the objectives are met to your satisfaction, and contracted outputs (deliverables) are delivered on time, within budget, within scope and to the required safety and quality.

The **Project Manager** will be **Cyprien Bosserelle** who will manage and lead the project on a day-to-day basis, to NIWAsafe standards, deliver contracted outputs (deliverables) on time, within budget, within scope and to the required quality, and maintain a good business relationship with the client. Cyprien Bosserelle is an inundation hazard modeller and the lead modeller for the proposed projecthe is an experienced tsunami modeller and main developer of BG-Flood model.

Emily Lane will assist in the development of the tsunami forecast system. Her expertise is in mathematical modelling, with specific interest in coastal hazards. One of her areas of specialisation is tsunamis. Emily has researched and modelled tsunami generation, propagation and inundation. Emily is also a member of the NZ Tsunami Experts Panel which responds to Pacific tsunami warnings/alerts.

Shaun Williams is a hazards and risk analyst with extensive understanding of the tsunami risk in Samoa and Tonga. Shaun also has in-depth experience in managing the delivery and installation of hazard/met/ocean monitoring stations and forecast system in Tonga and Samoa. Shaun will assist in the design and development of the tsunami forecast system and assist with the coordination of wavebuoy deployment training and implementation.

Bernard Miville was a meteorologist and sea ice forecaster and now the Coordinator, NIWA Product Database and Delivery. He is behind the recent development of the CliDEsc Portal piloted in Tonga. He will be coordinating and implementing the integration of forecast product in the CliDEsc Portal.

Rodd Bud is the principal technician for the Coastal and Estuarine Physical Process Team. He led the team that deployed the wave buoys (8) and water level sensors (14) in Tonga in 2018-2019. He will be coordinating the wave buoy preparation and training for this project.

6 Project management, terms and conditions

6.1 NIWA's project management system and quality assurance system

As with all NIWA projects, this project will be managed within our comprehensive Project Management System. This controls progress, expenditure, hazards, quality and delivery.

The Project Management System also includes NIWA's in-house quality assurance system. NIWA is a member of the New Zealand Quality Foundation and part of the NZQF quality self-assessment accreditation programme.

NIWA's quality assurance system was developed specifically for its science-based activities. It utilises a rigorous peer-review quality assurance process. This process is integral to developing project proposals, reports and other deliverables. Review steps for each project include:

- at least one peer review of the proposal especially methods, approach, data management, analyses and resourcing;
- progress reviews, notably hours worked against total hours and milestone achievement, and
- review of project documents (e.g., technical or progress reports) prior to release.

The project management system is also integrated with NIWA's personnel performance and development management system. In addition, NIWAsafe is central to successful project management with hazard management activity at each stage of the project's management.

6.2 Stay Safe with NIWA

The health, safety, and wellbeing of NIWA people and our partners working with us is at the forefront of what NIWA stands for. It is a core value for NIWA. We believe that conducting our worksafely and protecting people from harm is of paramount importance.

Our commitment is to always put safety first and manage our risks for the ultimate benefit of the health, safety, and wellbeing of our people. We continuously strive to achieve this through: (1) improving our safety leadership, (2) focusing on personal decision making, and (3) proving excellencein safety and wellbeing management.

Worker participation in NIWAsafe, our health and safety management system, is a central mechanism around which our project management work is planned and implemented. We maintainand actively update comprehensive safety information on our intranet which supports our Project Management System.

NIWAsafe policies, procedures, standards, and guidelines are focussed on keeping our people safe and meets all risk management, legislative, and regulatory requirements and codes of practice including applicable Maritime, Aviation, and Hazardous Substance requirements. This includes dutiesof care and responsibility to our employees, contractors, clients, and the public. We work with our clients to their health and safety expectations. Our standard contractual terms reflect a shared

approach to health and safety, with both parties having duties to consult on the identification, assessment and control of any hazards and risks associated with the project. The outcome of this shared approach is an agreed health and safety plan to manage those hazards and risks that has involved workers in its design and implementation. The parties will continue to consult with each other to manage health and safety hazards, and risks throughout the contract, and will meet regularly to review health and safety practices and implications for contract delivery. We will notifythe client of any health and safety incidents or events associated with the project.

Information regarding NIWAsafe practices is available by contacting the regional manager [insert name] at: [email]

All NIWA boating activities will operate under the NIWA Boating Code of Practice, which has the overall goal of achieving 'Safe and Successful Boating Operations' during the course of carrying out NIWA's research activities on NIWA-owned, or NIWA-contracted vessels. NIWA staff using boats hold commercial boating qualifications approved by Maritime NZ and have extensive field-based expertise. In addition to this, all NIWA boats are assessed in terms of their fitness for purpose and, as NIWA holds a Maritime Transport Operator Certificate (MTOC), are operated within the framework of the Maritime Operatory Safety System (MOSS).

Underwater diving has been identified by Work Safe NZ as a hazardous activity, and all NIWA divers have undergone full training and hold recognised certification for Occupational Scientific Diving. All authorised NIWA diving projects are conducted according to protocols laid down in the NIWA Code of Scientific Diving Practice (Diving Safety and Standards Manual). A copy of this code is registered with Work Safe NZ.

6.3 Insurance

NIWA carries comprehensive public liability and professional indemnity insurance coverage.

6.4 Intellectual property

Intellectual property originating from either party prior to the commencement of the contract, including that which is used for the purposes of providing the services, and all developments or adaptations of, shall remain the exclusive property of the party introducing that intellectual property.

Reports produced during the project, and paid for by FLTQ, will be owned by the client.

Diagrams or images used in this report may be subject to copyright and unless otherwise agreed with NIWA must not be reproduced without permission from their creator.

NIWA and [insert client name] will reach an agreement between them regarding ownership and use of any models and other outputs or deliverables from the services. Generally, NIWA expects to retain ownership of any models or significant data sets used as part of its operations or developed by it in order to perform the services, and all modifications, developments, or additions to those.

6.5 Terms of engagement

Reflecting standard business practice, unless otherwise agreed, NIWA will undertake the work pursuant to NIWA’s standard terms and conditions. Where appropriate, a copy of these is attachedto this proposal.

If those conditions are not acceptable to FLTQ, then NIWA may negotiate alternative contractual terms on a case-by-case basis.

For the avoidance of doubt this proposal, even if accepted by FLTQ, it does not constitute a contract, and NIWA will not be bound to provide the services until a formal contract has been entered into.

Any changes to the services, fees, or agreed personnel during the course of providing the services must be agreed to in writing.

- NIWA has not budgeted for external or peer reviews of the technical reports or final report by parties other than NIWA or the client.

6.6 Dependencies

NIWA's delivery of the proposed services and deliverables is dependent on:

- Sharing of early/draft versions of products for integration in Clidesc portal for each forecast component (Seasonal outlook by 30 April 2021, Swell inundation by 30 June 2021, Tsunami by 30 October 2021)
- Access to a shared repository for the forecast system code (by 1 March 2021)

Wave buoy deployment will depend on the local team completing the deployment and required task prior to the deployment (itself dependant on boat availability, and suitable weather window).

6.7 Impact of COVID-19

In preparing this proposal we have sought to factor in the likely impacts of the COVID-19 pandemic on our ability to provide the services. NIWA has robust systems in place to try and mitigate the potential impacts of Covid-19. However, we recognise that there remains a degree of uncertainty around how the COVID-19 crisis will progress and that even with goodsystems it may not always be possible to fully mitigate the impacts of Covid-19. Should any circumstances relating to COVID-19 affect the services or a party's performance of the contract, then our expectation is that that party will promptly notify the other party and the parties will negotiate in good faith appropriate variations to the contract as required to address the impact of these circumstances.

- Most of our office-based activities can be undertaken remotely by staff working from home. This includes activities such as data analysis and report writing.
- Should activities undertaken by NIWA staff be classified as essential services, a limited number of individuals will be authorised to continue to deliver these office, laboratory, and field-based services.

- The services covered in this proposal [are/are not] classified as essential services that could be authorised to continue.
- NIWA is willing to discuss Fundación Leonardo Torres Quevedo to try to accommodateany specific requirements it may have in relation to the management of COVID-19.

7 Validity

The proposal is valid for acceptance for 30 days from date of issue.

8 Confidentiality

This proposal, and the information it contains, is and shall remain the property of NIWA, and is to be treated as confidential. The information contained here may only be used (or disclosed) as reasonably necessary to assess NIWA's offer of services, for the inclusion of documentation for the engagement of NIWA, and for no other purpose. The proposal or any related information may not bedisclosed to any third party without first receiving NIWA's express written consent.

9 Professionalism and ethical standards

NIWA prides itself on the professionalism of all its staff and is committed to operating to the highest possible standards, and complying with all applicable laws, regulations, and codes of conduct (including as to expert evidence). Staff are required to act ethically, and with honesty and integrity atall times, and in accordance with NIWA's Professional Conduct policies. These policies, among other things, require staff to communicate openly, honestly, and constructively considering confidentiality obligations, and treat others with courtesy and respect.

NIWA respects cultural values and diversity, with the recognition that our diverse workforce and stakeholders are part of NIWA's strength. We have a zero-tolerance approach to any instances of fraud, bribery, or corruption. NIWA regularly undertakes audits of our systems and legal compliance.

NIWA's policies prohibit NIWA staff members from accepting any gift, entitlement, or physical token of appreciation that is given or offered by any current or potential clients or suppliers without express approval from their regional manager.

Staff are required to declare any actual or potential conflicts of interest before commencing work ona project, and as soon as they emerge during the project. Staff are also required to consider whetherNIWA itself has an interest in a matter that may conflict with a client's interests, and to remain alert to situations where NIWA's different clients may have competing interests. Any conflicts of interest will be addressed immediately by the project manager and project director and, as appropriate, managed and resolved with the client.

10 Contact us

For more particulars, including discussion and/or negotiation on methods, price or deliverables, please contact:

Cyprien Bosserelle
Hydrodynamics Modeller
Hydrodynamics

Phone: +64-3-341 2840
cyprien.bosserelle@niwa.co.nz

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1.Appendix A CVs of relevant staff

Curriculum Vitae

Dr Cyprien Bosserelle

NIWA Taihoro Nukurangi

Present position and institution

Hydrodynamics Modeller

National Institute of Water & Atmospheric Research Ltd, 10 Kyle Street, Riccarton, Christchurch

Email: Cyprien.bosserelle@niwa.co.nz Phone: +64-3-341 2840

Specialist expertise

- hydrodynamics, ocean surface waves and oceanography numerical modelling
- tide and ocean data analysis
- shoreline physical processes and geomorphology, morphodynamics simulation
- coastal Hazards assessments

Professional experience

(i) Summary of experience relevant to this proposal

I have been involved in coastal hazards research since my Master's studies in 2007. I have been involved in developing and testing different numerical models such as XBeach, developing tools for improving numerical assessment. More recently I have focussed on the effect of longwaves on coastal inundation and on improving the performance of numerical models in runup simulations. I maintain the codes for the XBeach_GPU and BG-flood models.

(ii) Example projects relevant to this proposal

CIFDP Fiji (2016) – Data collection and simulation of long waves on reef fringing reefs in Fiji and Tuvalu. Design of new methodologies for rapid generation of inundation maps for inundation forecasting for the Coral Coast of Fiji.

Christchurh City Council : Coastal sediment budget for Pegasus Bay (2018). Technical input for surfzone dynamics for longshore transport and sediment transport modelling.

Gisborne District Council : Level 3 tsunami evacuation zones for Gisborne Region(2019). Lead the tsunami modelling on dune erosion. Led the conversion of tsunami inundation extent to evacuation zones.

Academic qualifications

2006 MSc, Integrated Approach to Geological Hazards, University of Sciences and Technology, Montpellier, France

2013 PhD, Hydrodynamics and Sand Transport on Perched Beaches in Western Australia, University of Western Australia, Crawley, Western Australia

(iii) Recent professional positions held

- Coastal Oceanographer, Pacific Community, Suva, Fiji, July 2013 – July 2017
- Hydrodynamics Modeller, NIWA, Christchurch, July 2017 – present

(iv) Publications

Bosserelle, C., Gallop, S.L., Haigh, I.D., Pattiaratchi, C.B., (2021) The Influence of Reef Topography on Storm-Driven Sand Flux. Journal of Marine Science and Engineering. 9(3):272. https://doi.org/10.3390/jmse9030272

Paulik, R., Williams, S., Titimaea, A., **Bosserelle, C.**, Chan Ting, J., Simanu, L., (2021). Evaluating building exposure and economic loss changes after the 2009 South Pacific Tsunami. International Journal of Disaster Risk Reduction 56; https://doi.org/10.1016/j.ijdrr.2021.102131

Bosserelle, C., Williams, S., Cheung, K. F., Lay, T., Yamazaki, Y., Simi, T., et al. (2020). Effectsof source faulting and fringing reefs on the 2009 South Pacific Tsunami inundation in southeast Upolu, Samoa. Journal of Geophysical Research: Oceans, 125, e2020JC016537. https://doi.org/10.1029/2020JC016537

Williams, S., Titimaea, A., **Bosserelle, C.**, Simanu, L., Prasetya, G., (2020). Reassessment of Long-Term Tsunami Hazards in Samoa Based on Sedimentary Signatures. Geosciences 10(12), 481; https://doi.org/10.3390/geosciences10120481.

Kench P.S., Beetham E., **Bosserelle C.**, Kruger J., Pohler S.M.L., Coco G., Ryan E.J., (2017) Nearshore hydrodynamics, beachface cobble transport and morphodynamics on a Pacific atoll motu, In Marine Geology, https://doi.org/10.1016/j.margeo.2017.04.012.

Bosserelle C., Reddy S., Kruger J., (2016) Cost analysis of wave energy in the Pacific. Secretariat of the Pacific Community.

Gallop S. L, Collins M., Pattiaratchi C. B., Eliot M. J., **Bosserelle C.**, Ghisalberti M., Collins L.B., Eliot I., Erftemeijer P. L.A., Larcombe P., Marigomez I., Stul T., White D. J. (2015).
Challenges in transferring knowledge between scales in coastal sediment dynamics. *Frontiers in Marine Science.*

Gallop S. L, **Bosserelle C.**, Haigh I.D., Wadey M. P., Pattiaratchi C., Elliot I. (2015). The impactof temperate reefs on 34 years of shoreline and vegetation line stability at Yanchep, southwestern Australia and implications for coastal setback. *Marine Geology*

Bosserelle C., Reddy S., Movono M., Kruger J. (2015). Wave inundation on the Coral Coast of Fiji. *Coast and Port 2015 conference Proceeding.*

Oldham C., MacMahon K., Brown E., **Bosserelle C.**, Lavery P. (2014). A preliminary exploration of the physical properties of seagrass wrack that affect its offshore transport, deposition, and retention on a beach. *Marine Ecology Progress Series.*

Gallop S.L, **Bosserelle C.**, Elliot I., Pattiaratchi C., (2013). The influence of coastal reefs on spatial variability in seasonal sand fluxes. Marine Geology 344 DOI: 10.1016/j.margeo.2013.07.016

Bosserelle C., Pattiaratchi C., Haigh I.D. (2012) Inter-annual variability and longer-term changes in the wave climate of Western Australia between 1970 and 2009. *Ocean Dynamics*.

Lee, R. S., Black, K. P., **Bosserelle, C.**, & Greer, D. (2012). Present and future prolonged drought impacts on a large temperate embayment: Port Phillip Bay, Australia. *Ocean Dynamics.*

Gallop S.L, **Bosserelle C.**, Pattiaratchi C., Elliot I. (2012) The influence of coastal limestonelandforms on storm erosion and recovery of a perched beach. *Continental Shelf Research*.

Gallop, S.L., **Bosserelle, C.**, Pattiaratchi, C.B.., Eliot, I., Haigh, I.D. (2012) Geological structures influence coastal sediment transport over a cascade of scales. *Proceedings of the 33rd internation Conference on Coastal Engineering 2012.*

Gallop S.L, **Bosserelle C.**, Pattiaratchi C., Elliot I. (2011) Rock topography causes spatialvariation in the wave, current and beach response to sea breeze activity. *Marine Geology*.

Bosserelle C., Haigh I.D., Pattiaratchi C., Gallop S. (2011) Simulation of perched beachaccretion using Smoothed Particle Hydrodynamics (SPH). *Coast and Port 2011 conference Proceeding.*

Pattiaratchi C., Wijeratne S., **Bosserelle C.** (2011) Sand and seagrass wrack modelling in PortGeographe, South-Western Australia. *Coast and Port 2011 conference Proceeding.*

Gallop S.L, **Bosserelle C.**, Pattiaratchi C., Elliot I. (2011) Form and Function of Natural andEngineered Perched Beaches. *Coast and Port 2011 conference Proceeding.*

Gallop S.L, **Bosserelle C.**, Pattiaratchi C., Elliot I. (2011) Hydrodynamic and morphologicalresponse of a perched beach during sea breeze activity. *11th International Coastal Symposium Proceedings.*

Gallop S.L, **Bosserelle C.**, Pattiaratchi C., Elliot I. (2011) Rock topography causes spatialvariation in the wave, current and beach response to sea breeze activity. *Marine Geology.*

Borrero J.C., **Bosserelle C.**, Prasetya G., Black K.P. (2007) Using 3DD to model tsunamiinundation. *Coast and Port 2007 conference Proceeding.*

Borrero J.C., Goring D., **Bosserelle C.** (2007) Observations and modelling of the May 4th2006 Tonga tsunami in New Zealand. *Coast and Port 2007 conference Proceeding.*

Curriculum Vitae

Dr Emily Lane

NIWA
Taihoro Nukurangi

Present position and employer

Coastal Hazard Scientist, Hydrodynamics Group Manager: NIWA

Present work address

NIWA, 10 Kyle Street, PO Box 8602, Riccarton, Christchurch, New Zealand.

Specialist Skills

- Tsunamis, generation (including submarine landslide generated tsunamis) propagation and inundation modelling.
- Storm surge modelling.
- Coastal circulation modelling.
- Applied Mathematics.
- Natural physical hazards.
- Risk & vulnerability assessments.

Academic qualifications

1997 BSc, Mathematics, University of Auckland

1998 MSc (Hons), Applied Mathematics, University of Auckland 2000 MSc, Applied Mathematics, University of Arizona

2004 PhD, Applied Mathematics, Geophysics Minor, University of Arizona

Number of significant publications

32 consultancy reports, 29 peer-reviewed journal articles, 5 book chapters and 45 external presentations (in past 14 years).

Honours / distinctions / membership of societies, institutions, committees

- Member of the New Zealand Coastal Society.
- Member of GeoScience New Zealand.
- Member of the Tsunami Society International.
- Member of the American Geophysical Union.
- Member of the NZ Tsunami Experts Panel – responds to Pacific tsunamiwarnings/alerts.

Professional experience

Emily Lane's expertise is in mathematical modelling, with specific interest in coastal hazards. One of her areas of specialisation is tsunamis. Emily has researched and modelled tsunami generation, propagation and inundation. After the Kaikoura earthquake and tsunami, she spearheaded field surveys to understand the extent of the inundation and understand the

complexities of this event. She was part of a Natural Hazard Research Platform projects assessing the hazard to Wellington from submarine landslide generated tsunamis. Within this project she models both the initiating landslide and the tsunami. Emily Lane has been involved with tsunami inundation modelling project for various regional councils around NewZealand. She also has recently gained Marsden funding to investigate tsunamis generated by volcanic eruptions.

Recent professional positions held

- Programme Leader – Resilience to Hazards August 2018 – present
- Group manager, Hydrodynamics Group, NIWA, Christchurch, May 2013 – July 2018
- Hydrodynamics Scientist, NIWA, Christchurch, February 2006 – May 2013
- Postdoc, Institute of Geophysics and Planetary Physics, UCLA, USA, July 2004- 2006

Examples of recent relevant projects

Tsunami modelling and inundation maps for Canterbury and Kaikoura – *EnvironmentCanterbury [2010–2017]*
Project Manager and modeller for several tsunami inundation modelling and mapping projects to provide input to land-use planning and hazard management, focused particularly on Christchurch and Kaikoura. Worst-case South American and regional tsunami sources.

Multi-hazard assessment of Transpower substations - Transpower [2017]

Team member: Assessed tsunami hazard for Transpower substations as part of a multi-hazard assessment.

Coastal storm-tide and wave inundation maps and sea-level rise – *Greater WellingtonRegional Council [2011–2013]*
Project Manager for a combined storm-tide and wave set-up inundation modelling and mapping project to inform land-use planning and hazard management in the Wellington Region, both for the present-day extremes and with projected sea-level rise. The RiCOM model was used to derive the inundation depth layers for hazard maps.

Probabilistic tsunami modelling – *Auckland Council* [2010]
Team member: Modelled a suite of regional tsunami scenarios and combined them with tidal information within a probabilistic framework to provide a probabilistic hazard analysis of the tsunami hazard to Auckland's eastern coastline.

Relevant publications or reports (examples)

Refereed Publications:

Scheele, F.; T. Wilson; E.M. Lane; K. Crowley; M.W. Hughes; T. Davies; N. Horspool; J.H. Williams; L. Le; S.R. Uma; B. Lukovica; M. Schoenfeld; J. Thompson (2020) Modelling residential habitability and human displacement for tsunami scenarios in Christchurch, New Zealand. International Journal of Disaster Risk Reduction 43.

Williams, J.H.; T.M. Wilson, N. Horspool, R. Paulik, L. Wotherspoon, E.M. Lane, and M.W. Hughes (2020) Assessing Transportation Vulnerability to Tsunamis: Utilising Post-event Field Data from the 2011 Tohoku Tsunami, Japan, and the 2015 Illapel Tsunami, Chile. Natural Hazards and Earth System Sciences.

Paulik, R.; Lane, E.M.; Williams, S.; & Power, W. (2019). Changes in Tsunami Risk toResidential Buildings at Omaha Beach, New Zealand. Geosciences, 9(3).

Williams, J.H.; Wilson, T.M.; Horspool, N.; Lane, E.M.; Hughes, M.W.; Davies, T.; et al. (2019). Tsunami impact assessment: development of vulnerability matrix for critical infrastructure and application to Christchurch, New Zealand. Natural Hazards, 96(3),1167-1211.

Williams, S.; Zhang, T.R.; Chague, C.; Williams, J.; Goff, J.; Lane, E.M.; Bind, J.; Qasim, I.; Thomas, K. L.; Mueller, C.; Hampton, S. & Borella, J. 2018. 'Sedimentary and geochemical signature of the 2016 Kaikoura Tsunami at Little Pigeon Bay: A depositional benchmark for the Banks Peninsula region, New Zealand', Sedimentary Geology, 369: 60-70.

Lane, E.M.; Borrero, J.; Whittaker, C.N.; Bind, J.; et al. (2017), Effects of inundation by the 14th November 2016 Kaikoura tsunami on Banks Peninsula, Canterbury, New Zealand. Pure and Applied Geophysics, 174: 1855-1874.

Power, W.L.; Clark, K.J.; King, D.N.; Borrero, J.; Howarth, J.D.; Lane, E.M.; et al. (2017), Tsunami runup and tide-gauge observations from the 14 November 2016 M7.8 Kaikoura earthquake, New Zealand. Pure and Applied Geophysics.

Lane, E.M., Mountjoy, J.J., Power, W.L., and Mueller, C., (2016), Probabilistic Hazard of Tsunamis Generated by Submarine Landslides in the Cook Strait Canyon (New Zealand): Pure and Applied Geophysics, 173(12), 3757-3774.

Lane, E.M., Mountjoy, J.J., Power, W.L., Popinet, S. (2016) Initialising landslide-generated tsunamis for probabilistic tsunami hazard assessment in Cook Strait. International Journal of Ocean and Climate Systems, 4-13, 10.1177/1759313115623162

Smart, G.M., Crowley, K.H.M., Lane, E.M. (2016) Estimating tsunami run-up. NaturalHazards, 80(3): 1933-1947. 10.1007/s11069-015-2052-8

Power, W., Wang, X., Lane, E.M., Gillibrand, P.A. (2013) A probabilistic tsunami hazardstudy of the Auckland region, Part I: propagation modelling and tsunami hazard assessment at the shoreline. Pure and Applied Geophysics.

Lane, E.M., Gillibrand, P.A., Wang, X., Power, W. (2013) A Probabilistic Tsunami Hazard Study of the Auckland Region, Part II: Inundation Modelling and Hazard Assessment.Pure and Applied Geophysics.

Lane, E.M.; Gillibrand, P.A.; Arnold, J.R.; Walters, R.A. (2011) Tsunami inundation modellingusing RiCOM. Australian Journal of Civil Engineering 9(1).

(v) Client Reports (examples):

Bosserelle, C. and E. Lane (2019). Coastal storm surge inundation maps for the Kāpiti Coast. NIWA Client Report, Greater Wellington Regional Council: 64.

Bosserelle, C., Arnold, J., Lane, E. (2018) Land drainage recovery programme: tsunami study. NIWA Client Report, 2018039CH: 110. Prepared for: Christchurch City Council.

Lane, E., Bosserelle, C., (2017) Tsunami hotspots: a study of regions that react strongly in the event of a tsunami. NIWA Client Report, 2017341CH: 41.

Lane, E., Kohout, A., Sykes, J., Arnold, J., Bind, J., Williams, S. (2016) Distant tsunami inundation modelling incorporating dune failures and river flow in Christchurch. NIWA Client Report, 2016148CH: 51.

Lane, E.M., Arnold, J., Bind, J., Sykes, J., and Williams, S., (2016), Regional and distant sourcetsunami inundation modelling for Chatham Island. Chatham Islands Council.

Williams, S., Smart, G., Lane, E.M. (2015). Performance of the Waimakariri and Kaiapoi Rivers system and stop-banks in the event of a tsunami, Prepared for Environment Canterbury. NIWA Client Report CHC2015-0106, SCJ165REG. 16p.

Lane, E.M., Arnold, J., Williams, S., Sykes, J., (2015) Modelling tsunami inundation of Aramoana and Harrington Point, Dunedin. A 1:500-year 50th percentile scenario. NIWA Client Report CHC2015-101 DCC15502: 28.

Kohout, A., Lane, E.M., Arnold, J., Sykes, J., (2015) Hikurangi Subduction Zone and Wairarapa Fault tsunami modelling for the Canterbury coast. NIWA Client Report CHC2015-057 ENC14507/3: 125.

Mountjoy, J., Lane, E., Orpin, A., Woelz, S., Pallentin, A., Arnold, J.R. (2013) Kaikoura landslide tsunami hazard: investigation and analysis of potentially unstable sediment at the head of Kaikoura Canyon. NIWA Client Report, WLG2013-37: 55.

Gillibrand, P., Power, W., Lane, E.M., Wang, X., Sykes, J.R.E., Brackley, H., Arnold, J. (2010) Probabilistic hazard analysis and modelling of Tsunami inundation for the Auckland region from regional source Tsunami. ARC10502. NIWA, Christchurch: 62 p. Prepared for: Auckland Regional Council.

Lane, E.M., Walters, R.A., Arnold, J., Enright, M., Roulston, H. (2007) Auckland Regional Council Tsunami Inundation Study. NIWA, Christchurch: Prepared for: Auckland RegionalCouncil.

Curriculum Vitae

Dr Shaun Williams

NIWA
Taihoro Nukurangi

Present position and institution

Scientist – Natural Hazards and Risks

National Institute of Water & Atmospheric Research Ltd, 10 Kyle Street, Riccarton, Christchurch

Email: shaun.williams@niwa.co.nz Phone: +64-3-343 7880

Web Profile: https://www.niwa.co.nz/people/shaun-williams

Specialist expertise

- Hydrometeorological and geophysical hazards risk assessment and analysis.
- Stakeholder engagement and participation.
- Disaster risk reduction and management decision support.

Professional experience

(vi) Summary of experience relevant to this proposal

Shaun is a natural hazards analyst at NIWA with special interests in geophysical, hydrometeorological and climatic hazards/risk assessment and management in the Southwest Pacific region. His work covers a broad range of interdisciplinary subjects with emphasis in natural hazards and risk assessment, disaster management, stakeholder engagement and participation, early warnings systems and decision support.

(vii) Example projects relevant to this proposal

Tonga Government (via ADB funded) Tonga meteorological and coastal monitoring system development project 2018-2019 (ongoing) – design, procurement and implementation of meteorological and coastal monitoring/forecasting system development for Tonga.

NZ MFAT funded Pacific Risk Tool for Resilience (PARTneR) project, Samoa component, 2016-2019 – Flood, tsunami and landslide exposure and risk modelling analysis for targeted locations in Samoa. Included data management, standards development and capability strengthening for disaster and emergency management staff.

UNDP funded Establishment of Flood EWS in the Bumbu River catchment, Papua New Guinea, 2017-2018 – Installation of flood monitoring equipment in the Bumbu catchment, development of flood monitoring and warning SOP for PNG Met and Hydro services includingcapability strengthening.

Academic qualifications

2014: PhD, Hazard & Disaster Management, University of Canterbury, New Zealand.

2009: MSc (First Class Hons), Hazard & Disaster Management, University of Canterbury, New Zealand.

2003: BSc, Earth Science & Geography, University of the South Pacific, Suva, Fiji.

Relevant professional positions held

- Hazard Analyst, NIWA, Christchurch, New Zealand, May 2015 – present.

- NZ Fulbright Fellow, Visiting Researcher, University of Hawaii at Manoa, USA, January –December 2011.
- Senior Scientific Officer (Head of Geophysics Section), Samoa Meteorology Division,Ministry of Natural Resources and Environment, Samoa, December 2003 – January 2007.

(viii) Publications

Paulik, R., **Williams, S.**, Titimaea, A., Bosserelle, C., Chan Ting, J., Simanu, L., (2021). Evaluating building exposure and economic loss changes after the 2009 South Pacific Tsunami. International Journal of Disaster Risk Reduction 56; https://doi.org/10.1016/j.ijdrr.2021.102131

Bosserelle, C., **Williams, S.**, Cheung, K. F., Lay, T., Yamazaki, Y., Simi, T., et al. (2020). Effectsof source faulting and fringing reefs on the 2009 South Pacific Tsunami inundation in southeast Upolu, Samoa. Journal of Geophysical Research: Oceans, 125, e2020JC016537. https://doi.org/10.1029/2020JC016537

Williams, S., Titimaea, A., Bosserelle, C., Simanu, L., Prasetya, G., (2020). Reassessment of Long-Term Tsunami Hazards in Samoa Based on Sedimentary Signatures. Geosciences 10(12), 481; https://doi.org/10.3390/geosciences10120481.

Williams, S., Simi, T., Paulik, R., Giblin, J., Lin, S.-L., Scheele, F., Popovich, B. (2019) Risk modelling for tsunami, flood and landslide hazards, Samoa: PARTneR Case Study Series Samoa – Final Report (Draft). Prepared through the PARTneR Project. *NIWA Client Report 2019155CH.*

Williams, S., Porteous, A., Bosserelle, C., Bind, J., Rutherford, J., Fardman, E., Hyde, C., Miville, B., Taumoepeau, A., Budd, R., Powell, J., MacDonald, I. (2019). Design, Procurement and Installation of Tongan Meteorological and Coastal Monitoring System: Interim Report (Draft). Prepared for Ministry of Meteorology, Energy, Information, Disaster Management, Climate Change and Communications (MEIDECC), Tonga. *NIWA Client Report No. 2019153EI.* 35p.

Paulik, R., Lane, E., **Williams, S**., Power, W., 2019. Changes in Tsunami Risk to Residential Buildings at Omaha Beach, New Zealand. Geosciences 9(3), 113. DOI 10.3390/geosciences9030113.

Lin, S.-L., King, A., Horspool, N., Sadashiva, V., Paulik, P., **Williams, S., (**2019). Developmentand Application of the Real-Time Individual Asset Attribute Collection Tool. Frontiers in Built Environment. DOI 10.3389/fbuil.2019.00015.

Williams, S., Popovich, B., Holland, P., Sheele, F., Tari, J. (2018) Using Risk Tools for Resilient Decision Making. Training workshop delivered at the Understanding Risk Finance Pacific Conference, Port Vila, Vanuatu, 16-19 October 2018.

Williams, S., Singh, S., Tari, J., Simi, T., Holland, P., Popovich, B., Scheele, F., Ungaro, J., Lin,S.-L., Paulik, R., Porteous, A., Pearce, P., Ramsay, D. (2018) End-to-End: Risk data to decision-making: Examples from the Pacific region. Presentation at the Understanding Risk Finance Pacific Conference, Port Vila, Vanuatu, 16-19 October 2018.

Williams, S. (2018). Paleotsunamis in the Pacific: scientific update on the state of current affairs. Presentation at the Scientific Meeting of Experts to Understand Tsunami Sources, Hazards, Risk and Uncertainties Associated with the Tonga-Kermadec Subduction Zone, The Beehive, New Zealand Parliament Building, Wellington, 29 Oct – 2Nov 2018.

Williams, S., Gomoga, J., Porteous, A., Maiha, S., Elley, G. (2018) Flood and climate early warning systems development in Papua New Guinea: towards regionally consistent hydroclimatic monitoring and warning systems to support disaster resilience in the Pacific. Presentation at the Asia Pacific Economic Cooperation (APEC) 12th Senior Disaster Management Officials Forum, Kokopo, New Britain, 25-26 September 2018, Papua New Guinea.

Williams, S.P., Zhang, T., Chague-Goff, C., Williams, J., Goff, J., Lane, E.M., Bind, J., Qasim, I.,Thomas, K-L., Mueller, C., Hampton, S., Borella, J., 2018. Sedimentary and geochemical signature of the 2016 Kaikōura Tsunami at Little Pigeon Bay: a depositional benchmark for the Banks Peninsula region, New Zealand. Sedimentary Geology 369:60-70. DOI 10.1016/j.sedgeo.2018.03.013.

Power, W.L., Clark, K., King, D.N., Borrero, J., Howarth, J., Lane, E.M., Goring, D., Goff, J., Chague-Goff, C., Williams, J., Reid, C., Whittaker, C., Mueller, C., **Williams, S.**, Hughes, M., Hoyle, J., Bind, J., Strong, D., Litchfield, N., Benson, A., 2017. Tsunami runup and tide-gauge observations from the 14 November 2016 M7.8 Kaikoura earthquake, New Zealand. Pure and Applied Geophysics. DOI 10.1007/s00024-017-1566-2.