

A la atención del Director Gerente de la FLTQ D. Jorge Castro:

El Grupo de Ingeniería Geomática y Oceanográfica de la Universidad de Cantabria junto con el Centro NIWA de Nueva Zelanda, están desarrollando un proyecto para el World Bank sobre Riesgos de Desastres Naturales en los países de Samoa y Tonga. NIWA está desarrollando las tareas relacionadas con la inundación costera producida por tsunamis generados por maremotos (terremotos submarinos que desplazan la corteza del fondo de los océanos y generan una ola que se propaga hacia la costa, denominada *tsunami*).

La reciente erupción volcánica en la isla de Hunga Tonga en enero de 2021 ha producido un tsunami que se ha producido importantes inundaciones en Tonga, en Samoa, y en otras zonas costeras del Océano Pacífico. El Banco Mundial ha solicitado al Grupo GeoOcean una extensión del proyecto considerando la ola de tsunami que se produce por erupciones volcánicas. Por este motivo, se solicita la extensión del alcance de los trabajos con NIWA, para considerar no sólo tsunamis generados por maremotos, sino también tsunamis generados por erupciones volcánicas.

En el apéndice adjunto se detalla las tareas a desarrollar por NIWA.

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## Apéndice

### **Revised methodology for including volcanic eruption tsunami**

The recent Hunga Tonga-Hunga Ha'apai (hereafter HTHH) eruption and tsunami has brought new perspectives on possible tsunami impacts from active volcanoes in Tonga and Samoa. Indeed, the observed HTHH tsunami locally was much larger than expected from a landslide on the volcano slope. This new information from the HTHH eruption suggest that several tsunami generation mechanisms were at play at the same time amplifying the tsunami heights (flank and/or caldera collapse, pyroclastic column collapse, as well as atmospheric response to the eruptive explosion). This suggests that the HTHH tsunami likely represents the upper range of possible tsunamis associated with active volcanoes along the northern Tonga-Kermadec subduction zone. The initial intent of the proposed work was to focus on slope-failure type mechanisms on the flank of active volcanoes in the region. Instead we propose to revise the methodology to assess inundation of a HTHH tsunami happening at other active volcanoes in this region.

There are many uncertainties remaining on the mechanisms of tsunami generation of the HTHH tsunami and many of these uncertainties will take many years of research to unravel. However, observations of the HTHH event will allow us to create an initial tsunami that approximates the actual timing/mechanisms of tsunami generation.

#### **Task 1: Replicate HTHH tsunami (April 2022)**

This task involves the identification of a broad-scale generation mechanism and approximate an initial tsunami that reproduces the main characteristics of the tsunami as observed from DART buoy NZG, Tonga tide gauges (Nuku'alofa and Neiafu) and the inundation extent observed in Tongatapu. To achieve this a set of possible initial tsunami waves will be simulated at a regional scale and results will be compared with tsunami records/observations to identify the closest match. This process will require an iterative approach and involvement of NIWA's marine geologists and volcanologists to ensure that the derived tsunami wave is consistent with known eruption processes. The resulting best match will be relatively independent of the relative contribution of the different generation mechanisms whether from the eruption itself, caldera-, flank- or pyroclastic column-collapse, or atmospheric response on the explosive eruption.

#### **Task 2 apply HTHH tsunami to the Tonga and Samoa active volcanic fields (June 2022)**

With the view that the HTHH tsunami is representative of the upper bound of volcano-driven tsunamis in the region, applying the HTHH tsunami "closest match" initial tsunami wave to the main active volcanic fields in Tonga and Samoa will produce a useful volcanic tsunami hazard inundation assessment for both Tongatapu and Samoa for volcanoes comparable to HTHH (i.e. underwater shallow caldera in the same order of magnitude size as HTHH with historical signs of activities): Fonuafu'ou, Tofua-Kao, Late'iki, Fonualei-Toku, and Vailulu'u (Figure 1).

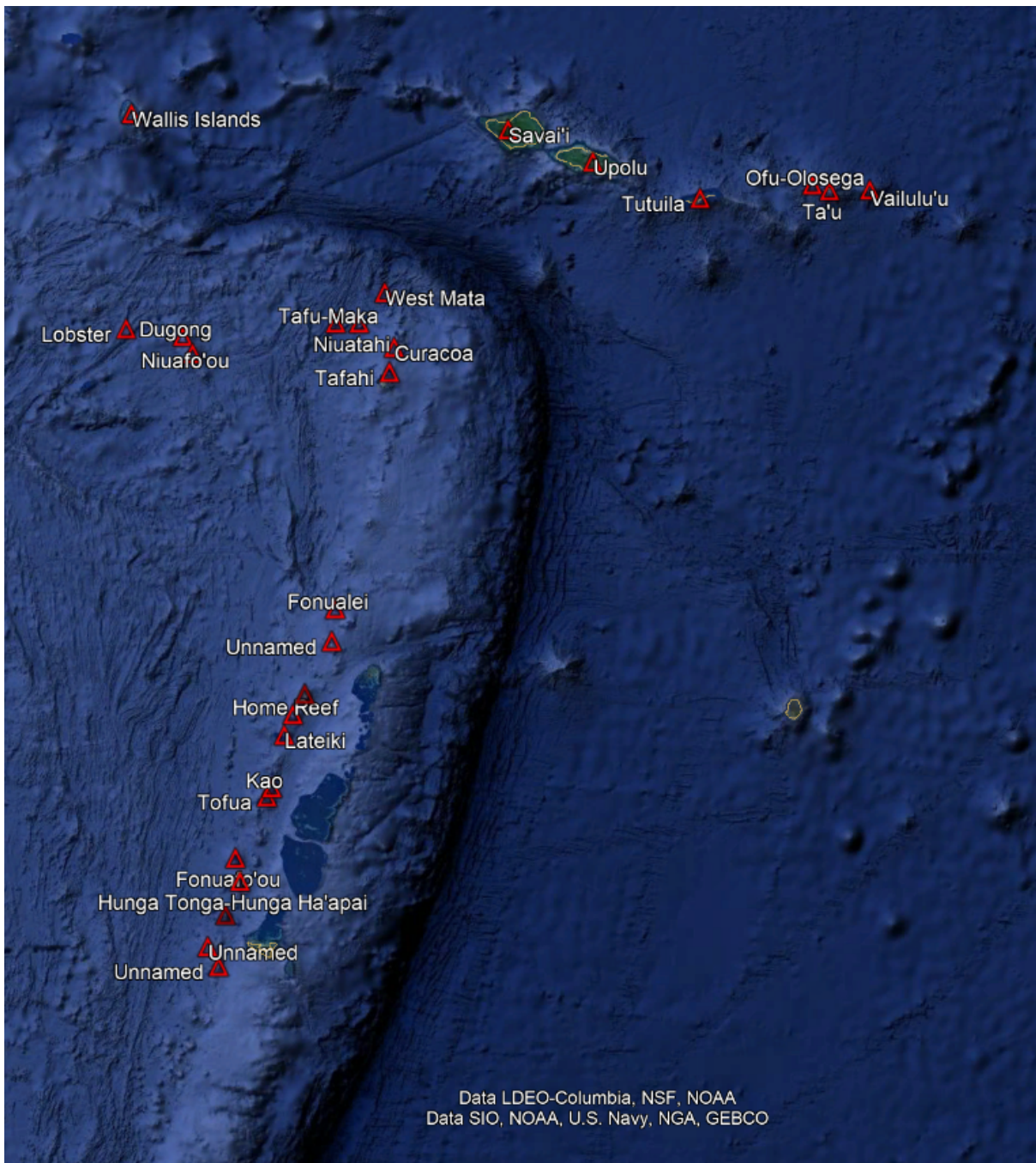


Figure 1. List of the Holocene Volcanoes in Tonga/Samoa region. Note not all the volcano listed above are susceptible of large eruption or tsunami generation. (Source: GVP 2013)

**Reference:**

Global Volcanism Program (GVP), 2013. Volcanoes of the World, v. 4.10.5 (27 Jan 2022). Venzke, E (ed.). Smithsonian Institution. Downloaded 07 Feb 2022. <https://doi.org/10.5479/si.GVP.VOTW4-2013>.