NIWA-Nippon Foundation Tonga Eruption Seabed Mapping Project

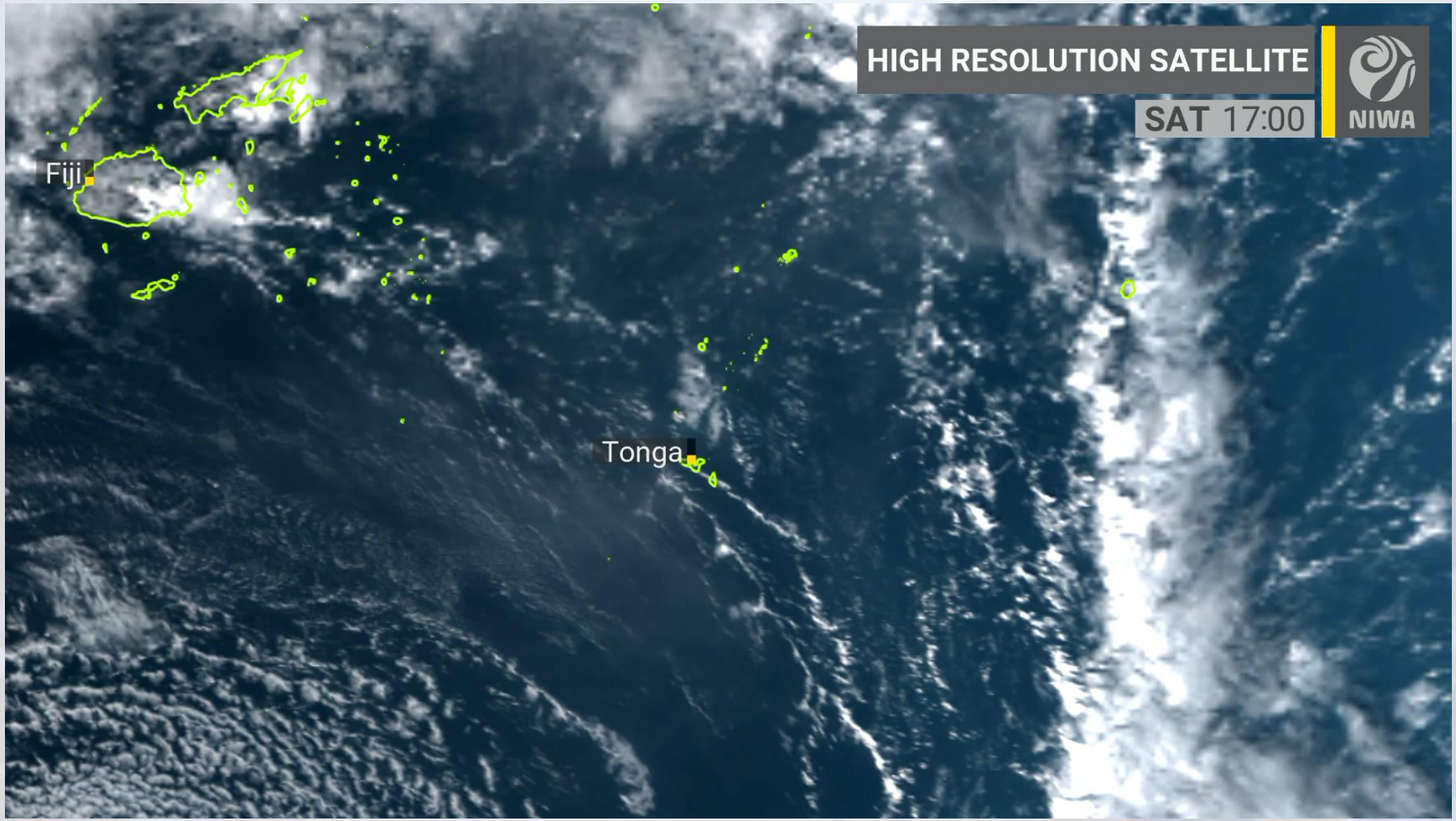
Seabed mapping of an active volcano in Tonga

Kevin Mackay
Mike Williams, Karolina Zwolak, Shereen Sharma, and Ben Simpson

5th South & West Pacific Regional Meeting, Lima, Peru
12-13 July 2023


Newshub

15 January 2022 VEI-6 Tonga Eruption

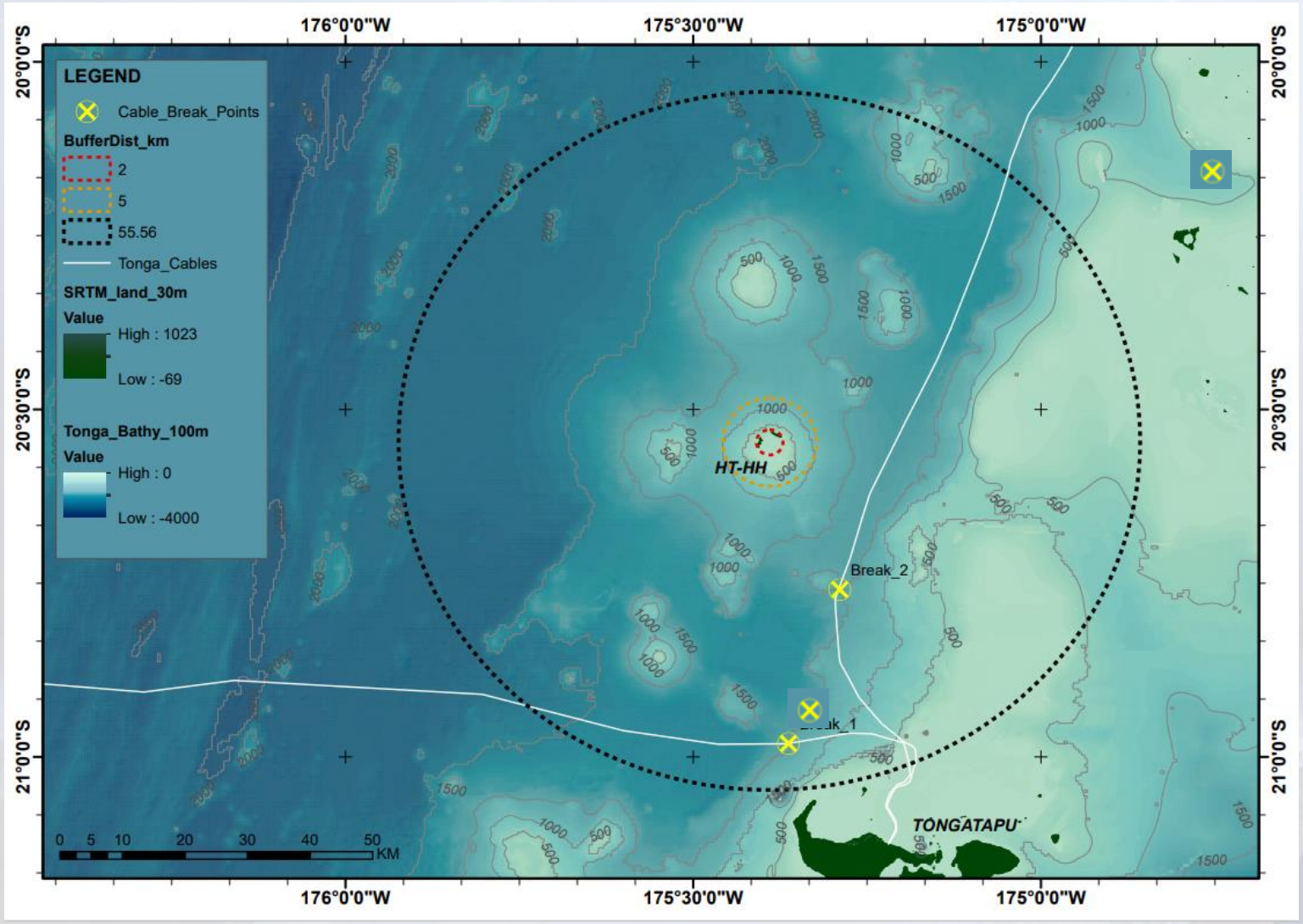


Officer Esafe Vuki - Tongan Maritime Force

Tsunami waves caused by the eruption

15 January 2022 VEI-5 Tonga Eruption

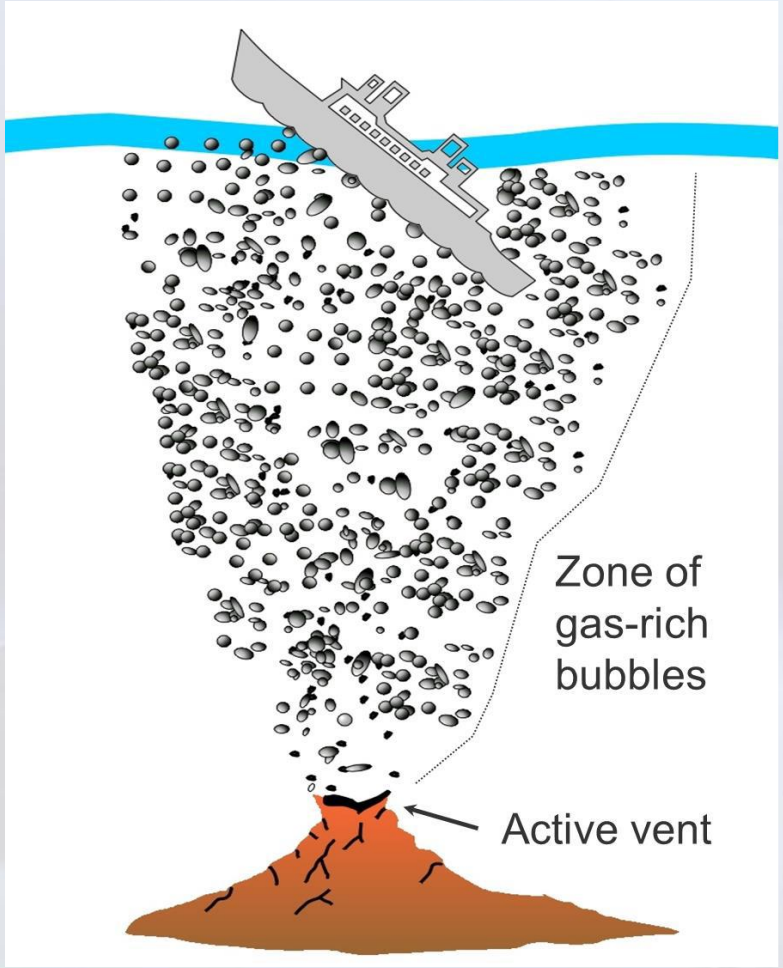
- 3 deaths in Tonga
- 80 per cent of Tonga population impacted by eruption and tsunami
- Underwater communications cables cut
- Crops, livestock, freshwater, fisheries badly affected
- ~US$90.4M in damages –approx. 18.5% of Tonga's Gross Domestic Product (GDP)



Major Seafloor change

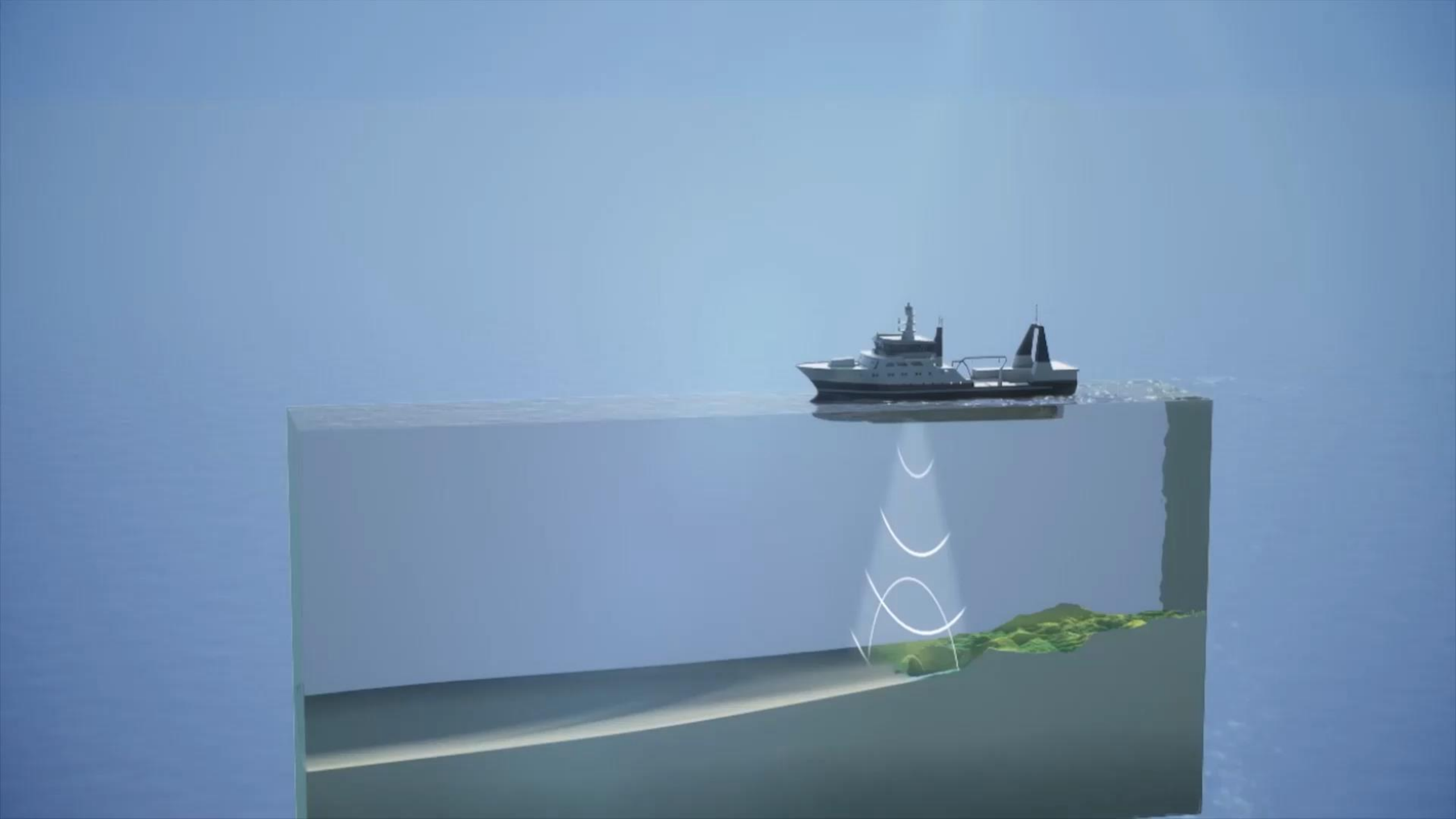
- At least 6000 km^2 of seafloor changed by the eruption

Submarine volcanic activity creates a significant hazard to maritime transport.



Effect of Lowered Water Density

- Area of lowered water density above the active vent that is saturated in gas-rich bubbles
- Vessel enters area of lower water density and looses buoyancy
- Depending on the magnitude of buoyancy loss, vessel may sink



USV Maxlimer

11.75 metres long

2.2 metres wide

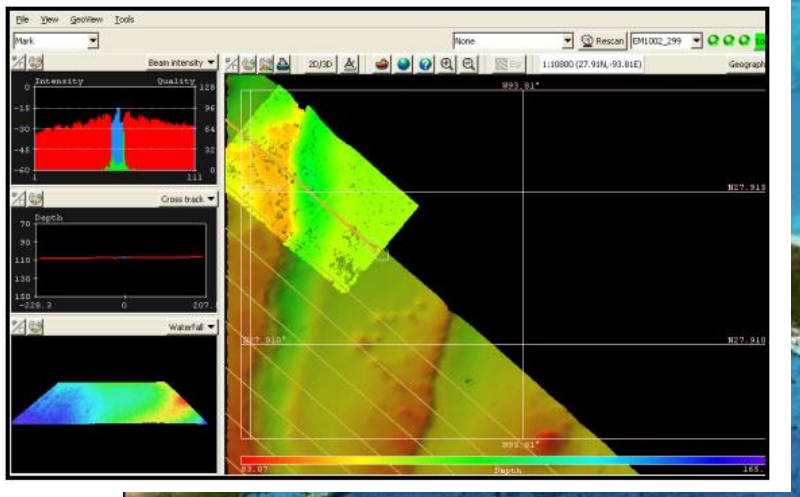
Max. speed 4 knots

Endurance 14 days

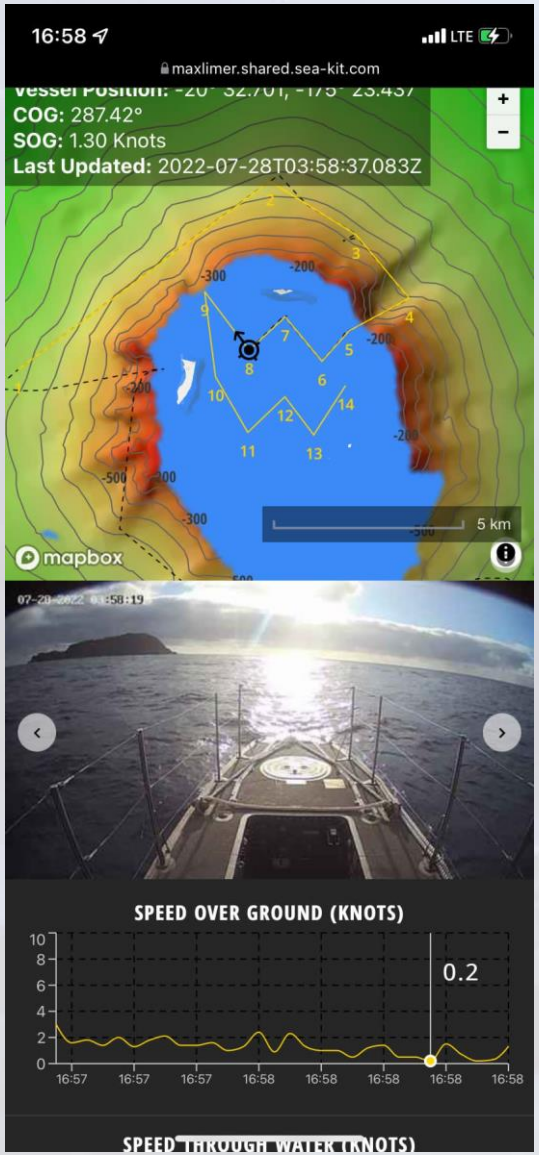
EM710 MBES

USV Maxlimer

Controlled in Essex, UK

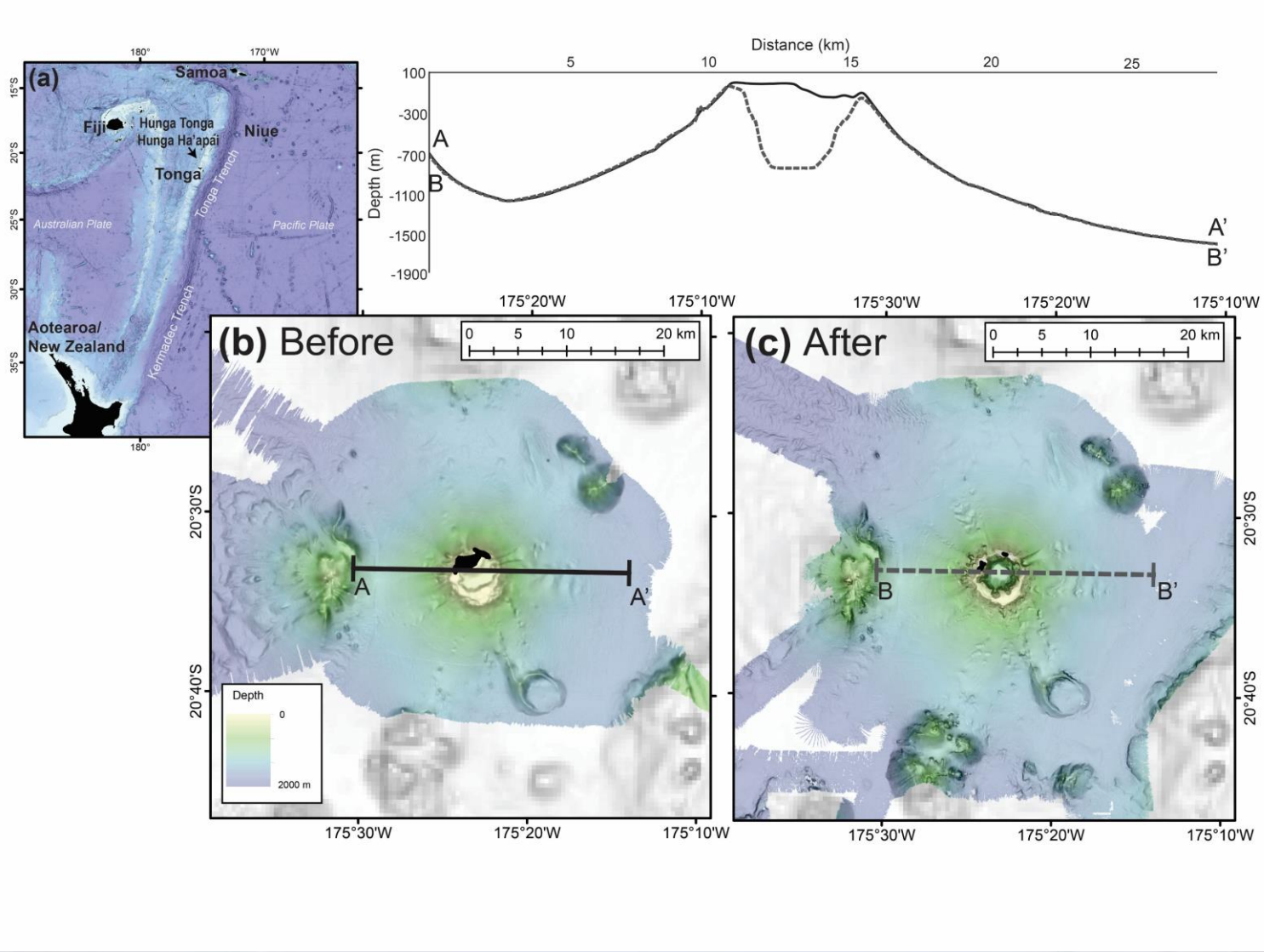

File View GeoView Tools
Beam intensity
Intensity
Quality
Cross track
Depth
Waterfall
2D/3D
Depth

GEBCO



USV Maxlimer on survey

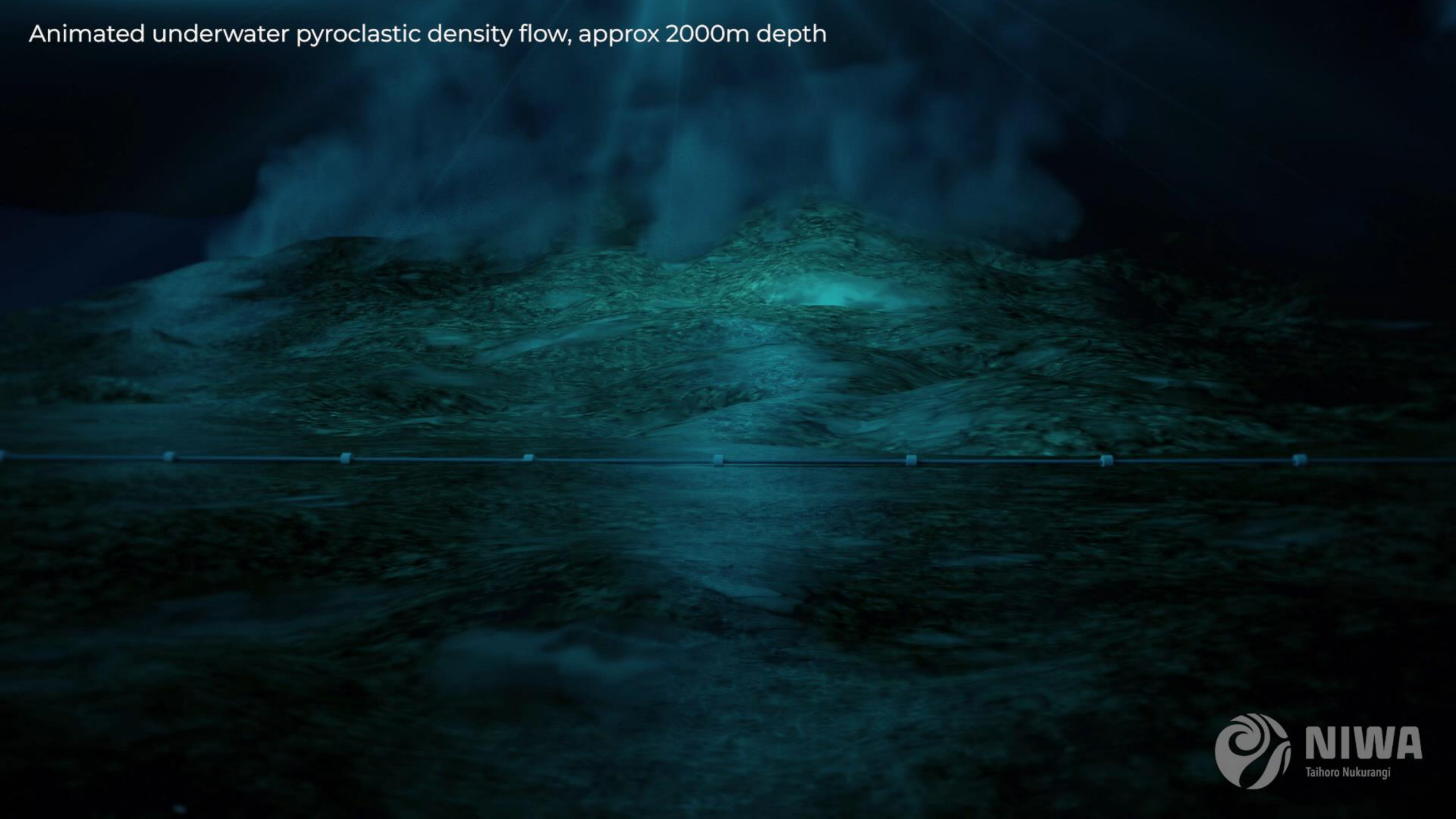
Remotely operated MBES, CTD, MAPR



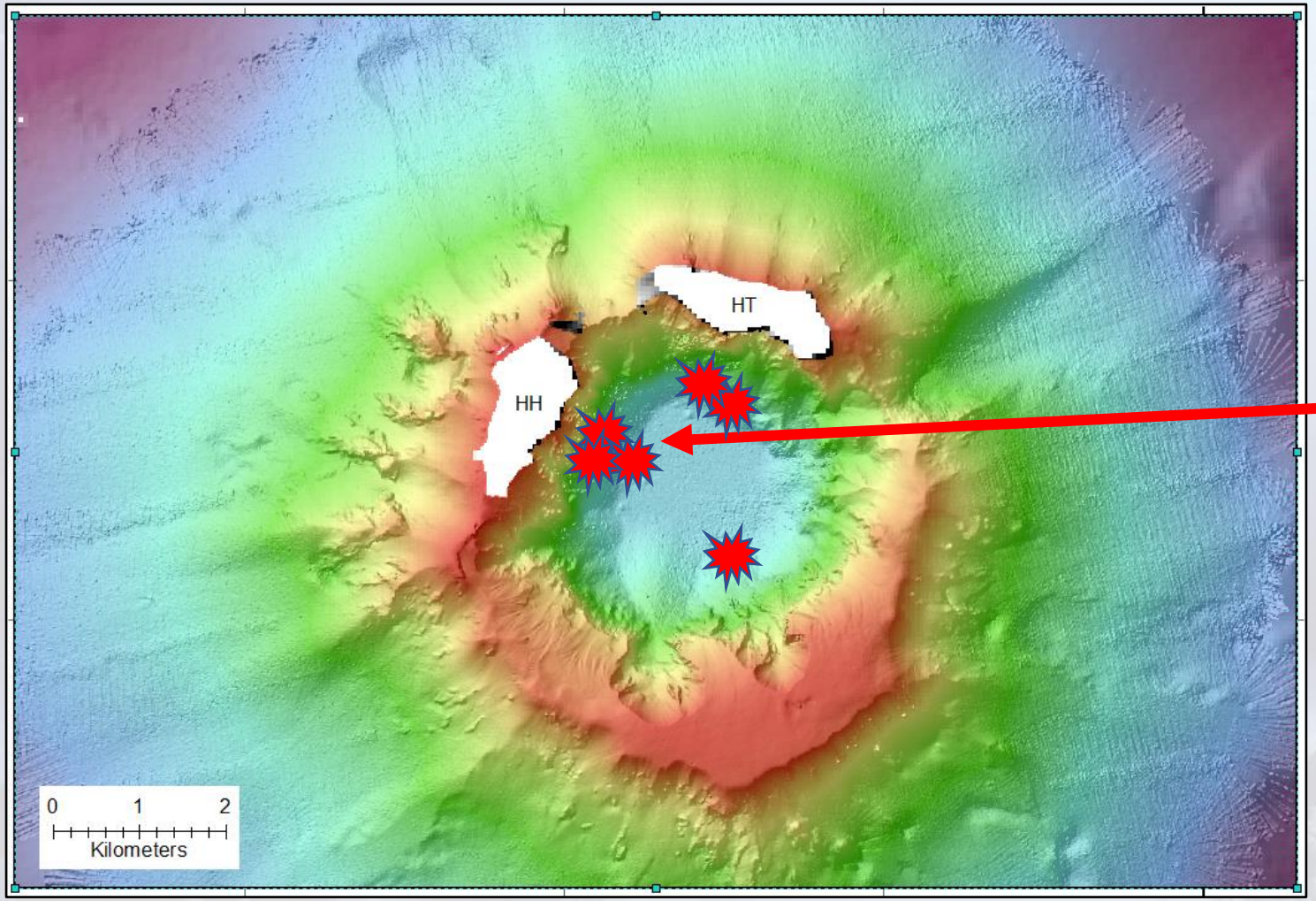
Major Seafloor change

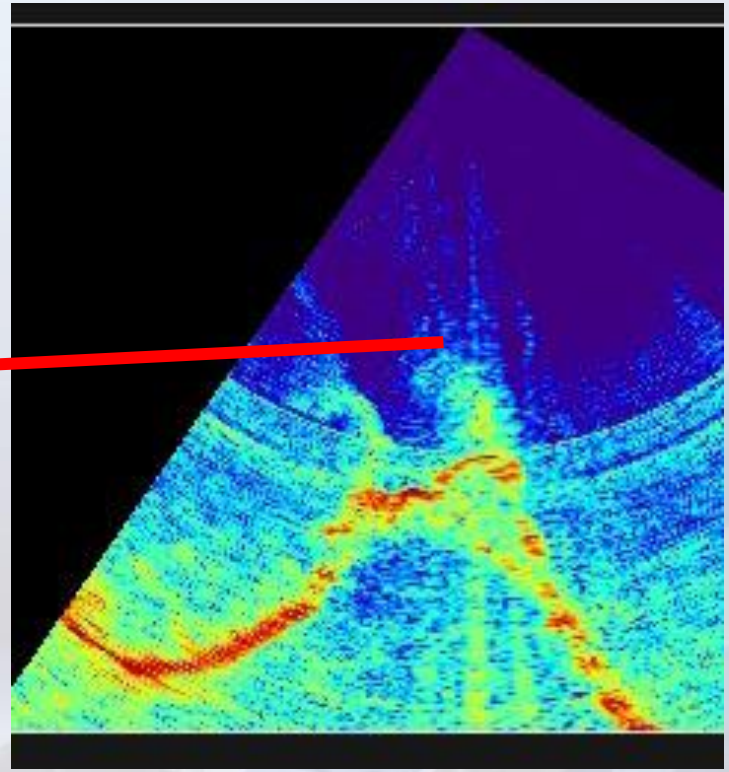
- Massive summit crater
- Many underwater pyroclastic flows
- ~9.5 km^3 seafloor removed
- ~6.7 km^3 added
- 2.8 km^3 unaccounted

Seabrook et al. 2023 (in press) https://www.researchsquare.com/article/rs-2395332/v1


Animated underwater pyroclastic density flow, approx 2000m depth
NIWA
Taihoro Nukurangi

Hydrothermal venting





Thank you