

# TONGA

**This story takes you on a journey to Tonga, where in 2018, iXblue mapped the seafloor to update nautical charts. The expedition revealed, in unprecedented detail, beautiful atolls, coral reefs and underwater volcanoes!**





**BREAKING  
NEWS**

UC San Diego



SCRIPPS INSTITUTION OF  
OCEANOGRAPHY



SOUTH PACIFIC OCEAN  
TONGA OR FRIENDLY ISLANDS

# NOMUKA GROUP

SURVEYED BY COMMANDER ANDREW F. BALFOUR, R.N.

Assisted by Lieut<sup>ts</sup> G.W. Gubbins, C.E. Monro, B.T. Somerville, S.C. Weigall, A. Waugh, & M<sup>r</sup> T. Rice, R.N.  
H.M. Surveying Ship "Penguin". 1895.

and by Captain A. Mostyn Field, R.N.

assisted by Lieut<sup>s</sup> F. C. Pasco, J.A. Waugh, G.E. Nares, A.W. Lewis, C.R. Brewis, & M<sup>r</sup> F. Payne, R.N.  
H.M. Surveying Ship "Penguin". 1898.

Observation Spot + (Nomuka I.) Lat.  $20^{\circ}15'36''$  S. Long  $174^{\circ}48'5''$  W.

*Bearings refer to the True Compass and are given from Seaward (thus:  $-126^{\circ}$  etc.)*

*Underlined figures express in Feet Drying Heights above Chart Datum.*

*All other Heights are expressed in Feet above Mean High Water Springs.*

## SOUNDINGS IN FATHOMS

Natural Scale  $\frac{1}{72,600}$  (at Lat.  $20^{\circ}00'$ )

Projection - Mercator

## SATELLITE-DERIVED POSITIONS

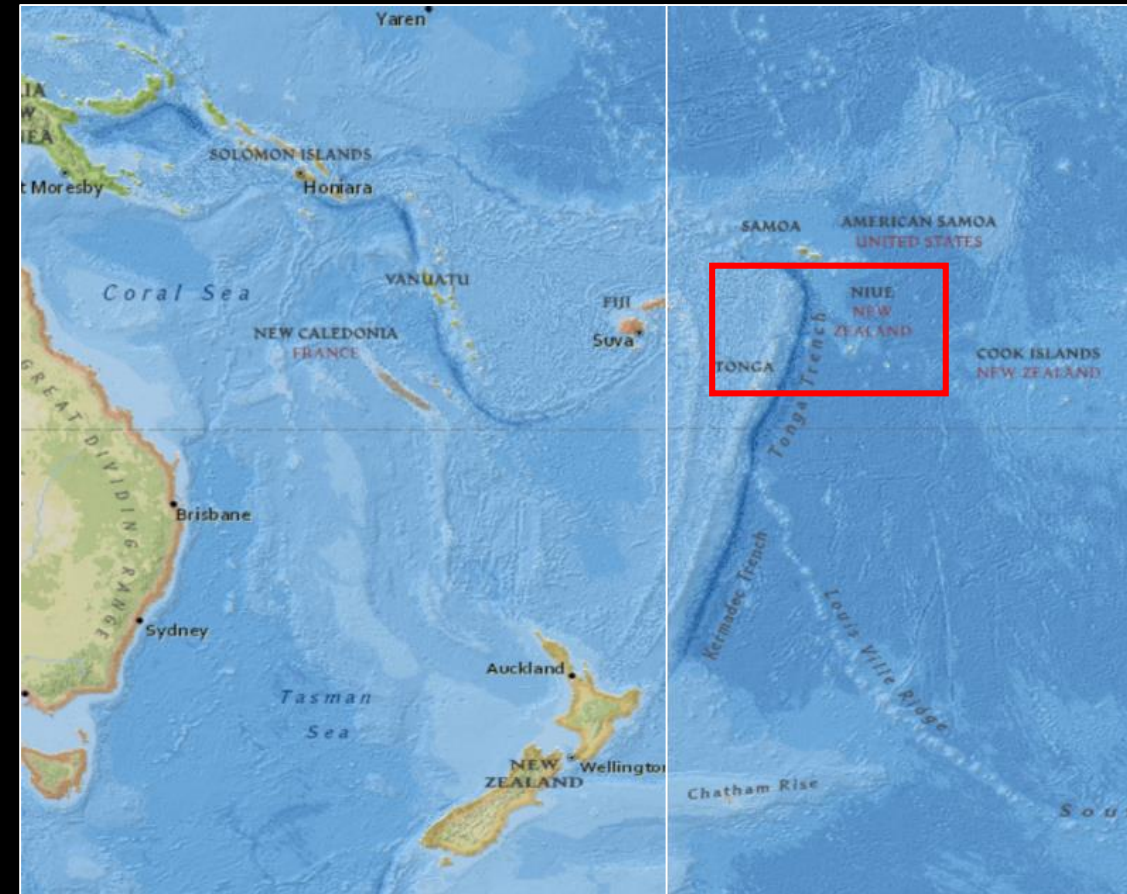
Positions obtained from satellite navigation systems are normally referred to the World Geodetic System (WGS); adjustments for plotting such positions cannot be determined for this chart and should be used with extreme caution.

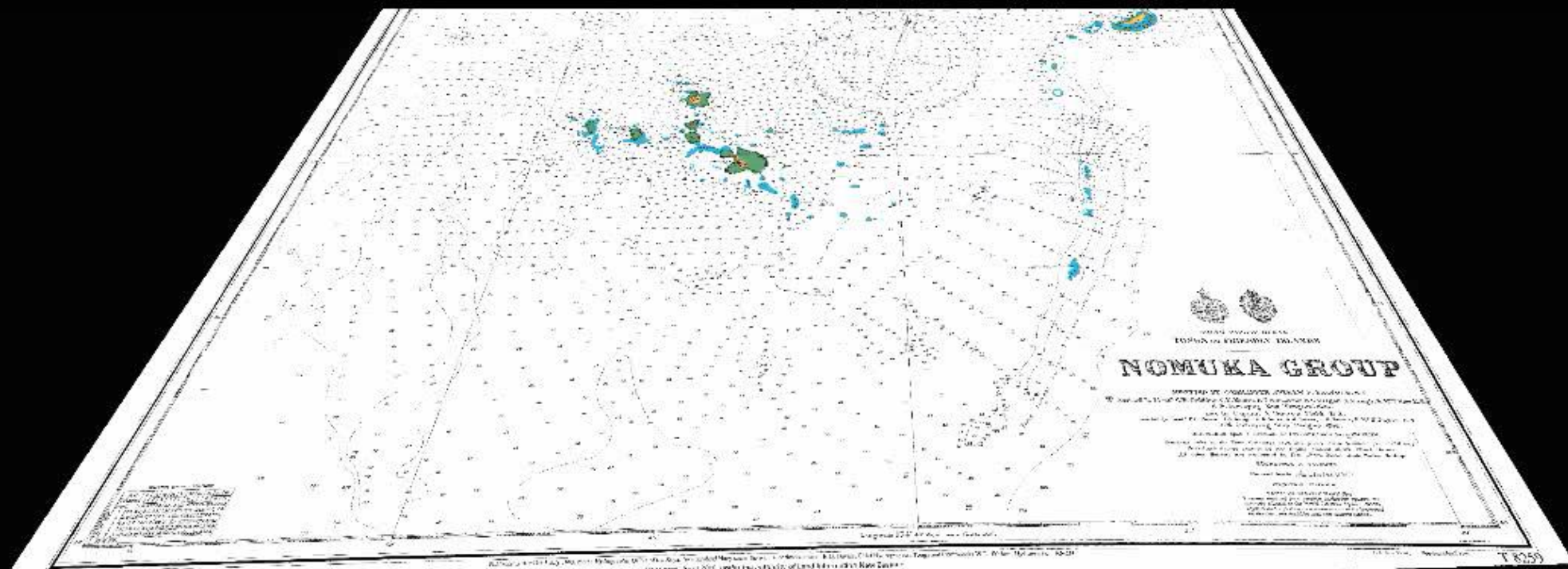
Much of Tongan waters have charts that have not been updated since the late 1800's. With fresh eyes and the latest in seafloor mapping technology, LINZ and iXblue, are mapping the bottom of the ocean to map navigation safer and chart undocumented features on the seafloor.



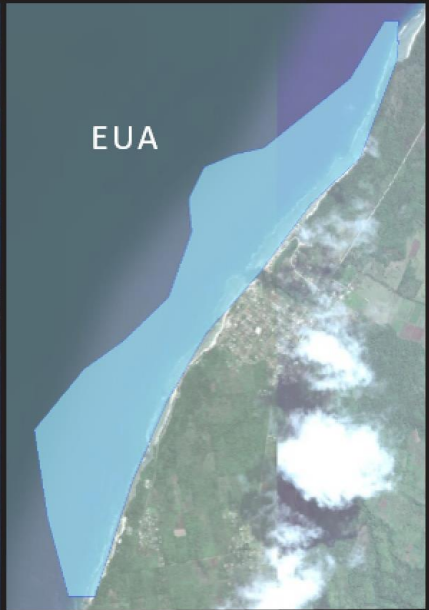
# LINZ HI 60, 61 & 62

- Tonga, Niue and Beveridge Reef
- Combined Approach
  - SDB (Satellite Derived Bathymetry)
  - ALB (Airborne Laser Bathymetry)
  - MBES (Multibeam Echosounder)
  - Tide gauge install & datum computations
- Requirement: LINZ HYSPEC
- iXblue Survey team: EOMAP, Geomatics Data Solutions and iXblue

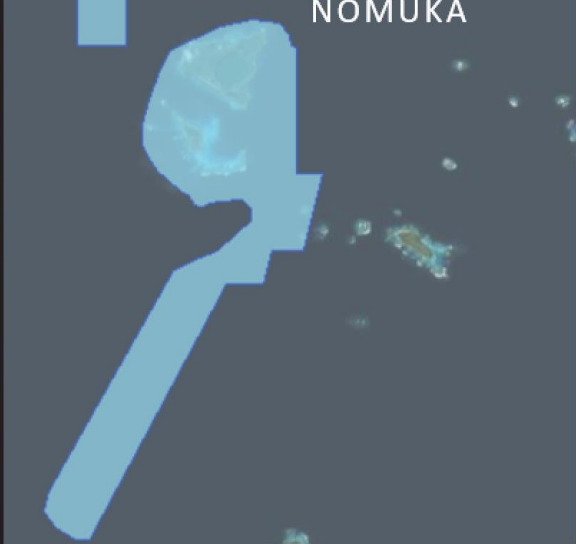








Airborne  
LiDAR







Kooringal

Amity

Point Lookout

North Stradbroke Island

Peel Island

Dunwich

North Stradbroke Island

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

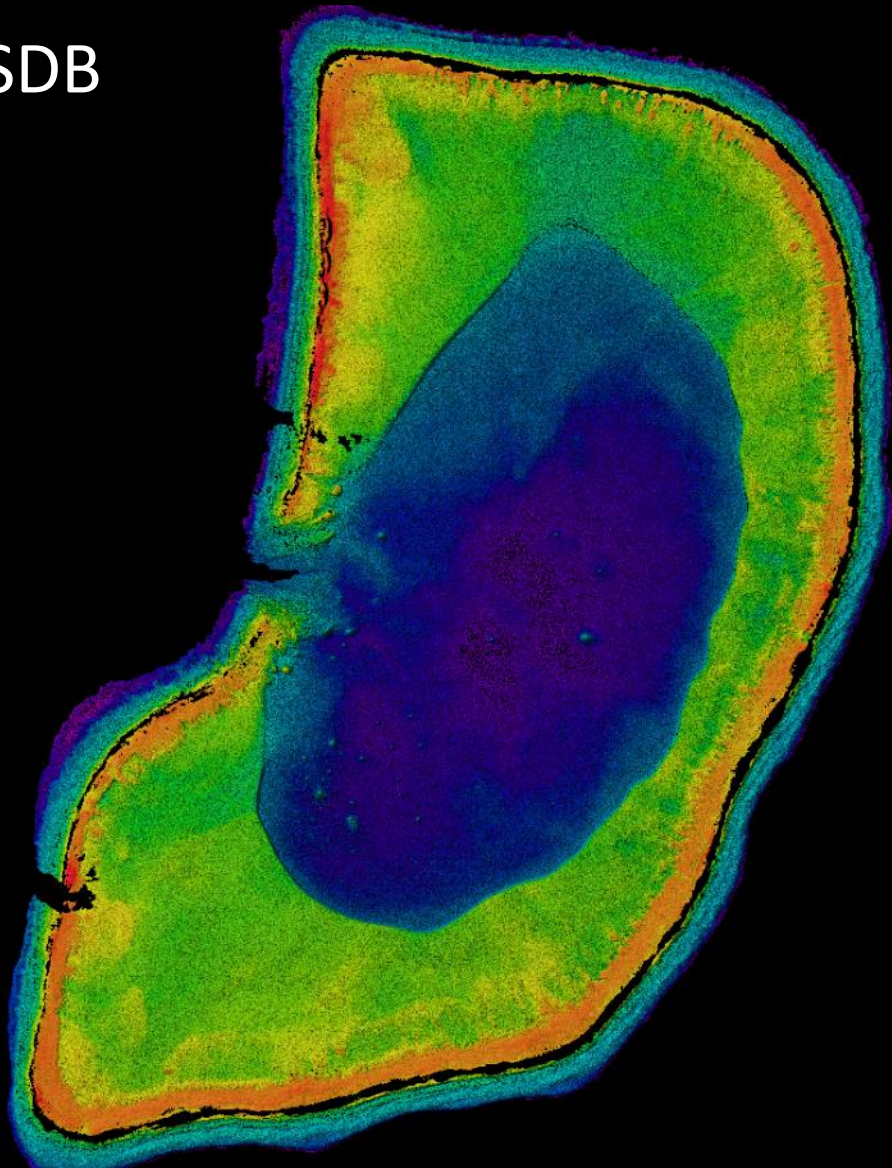


1 TO SCALE

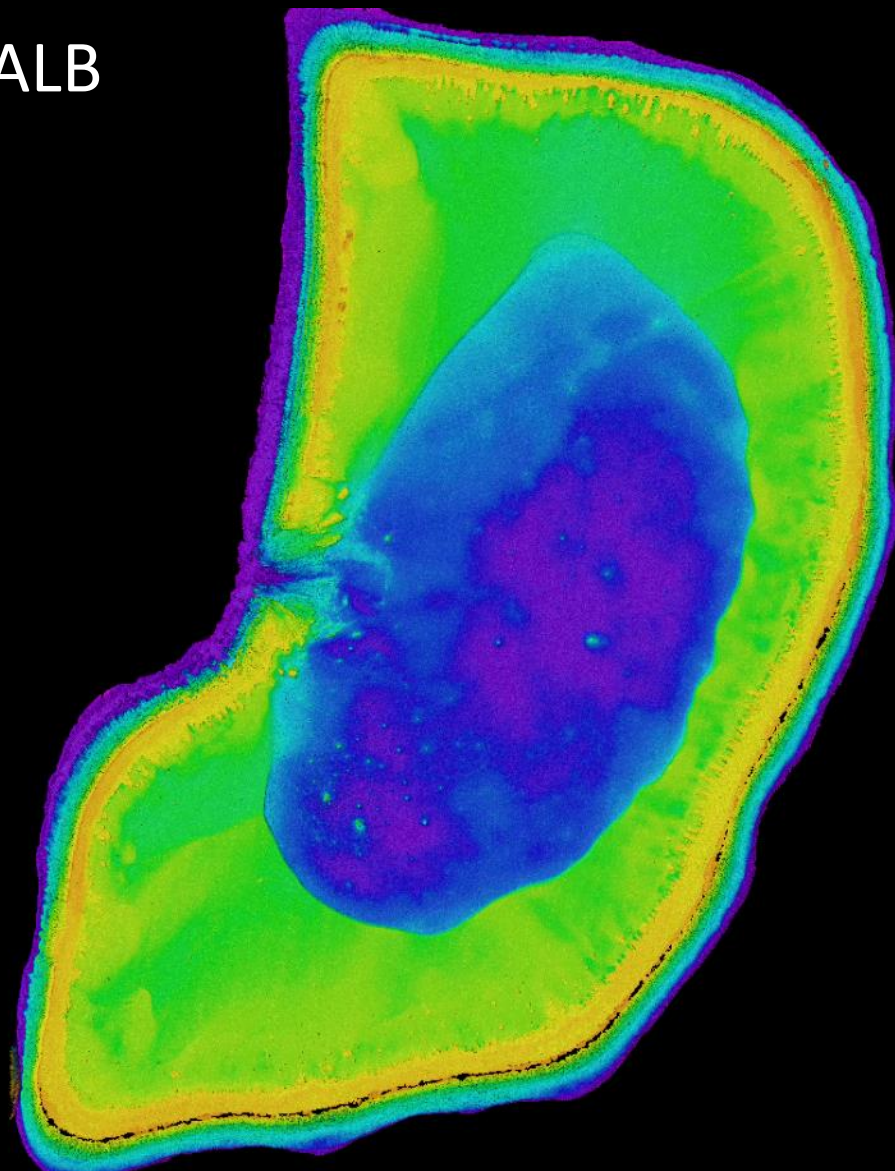
Google Earth



SDB

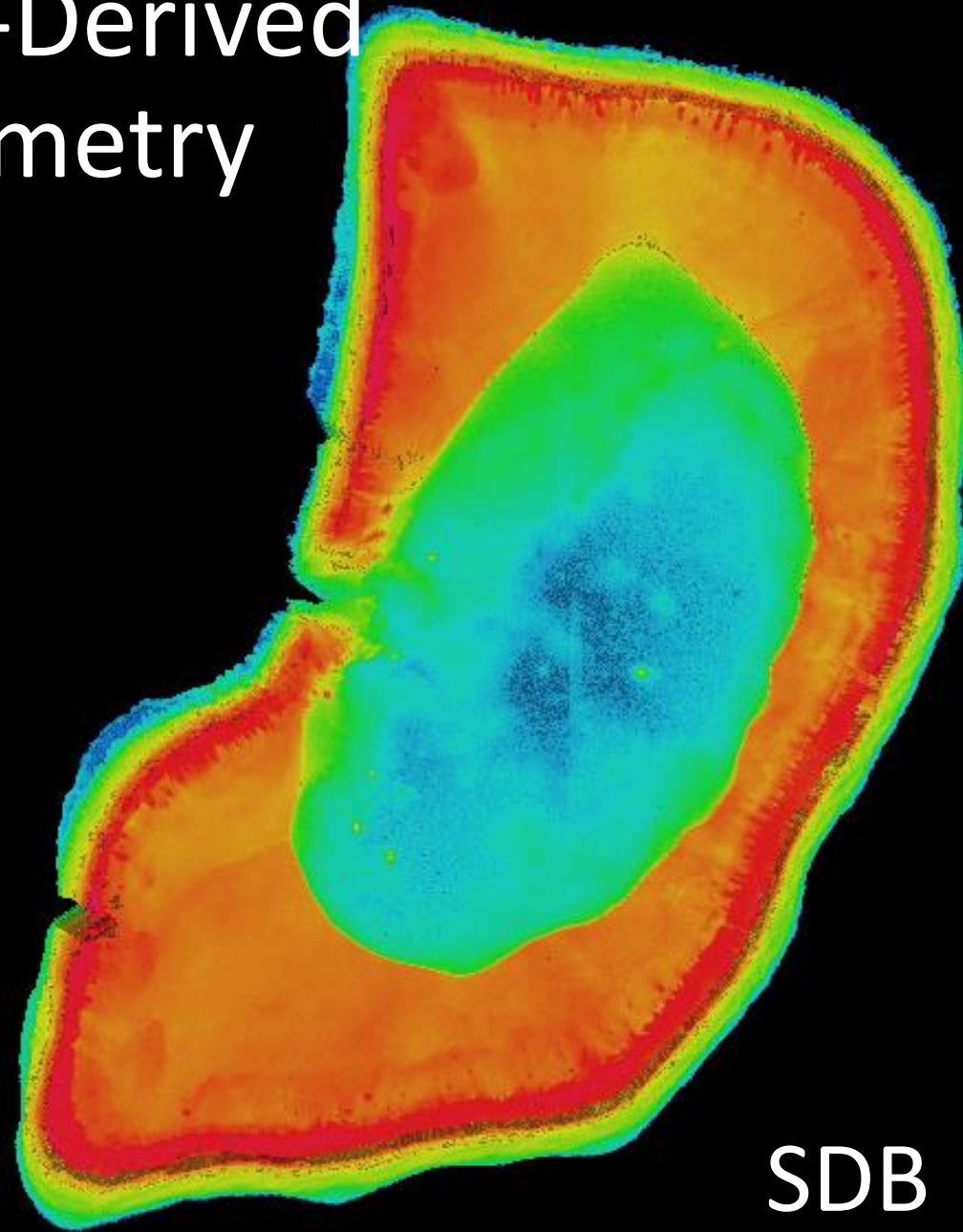
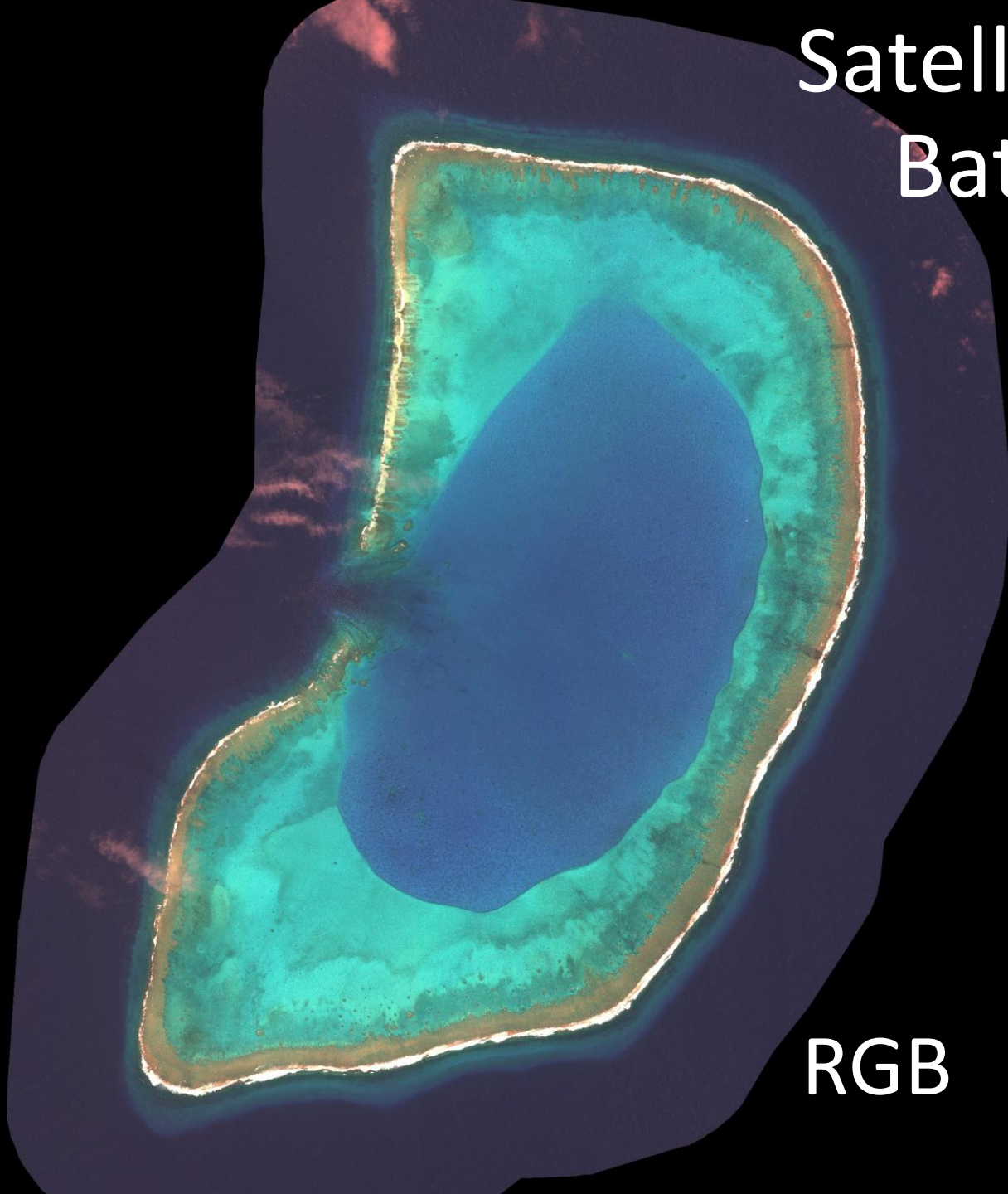


ALB





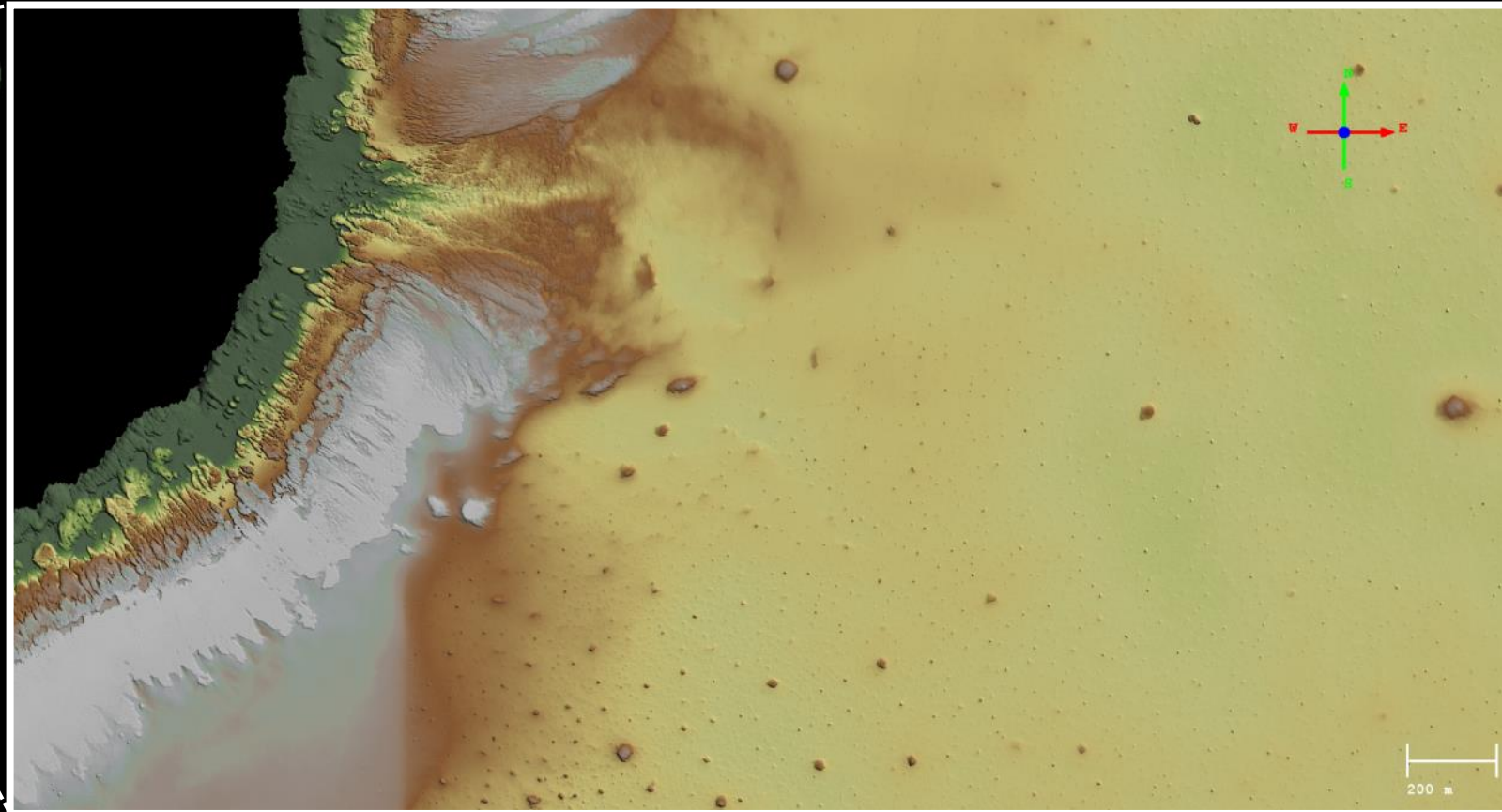
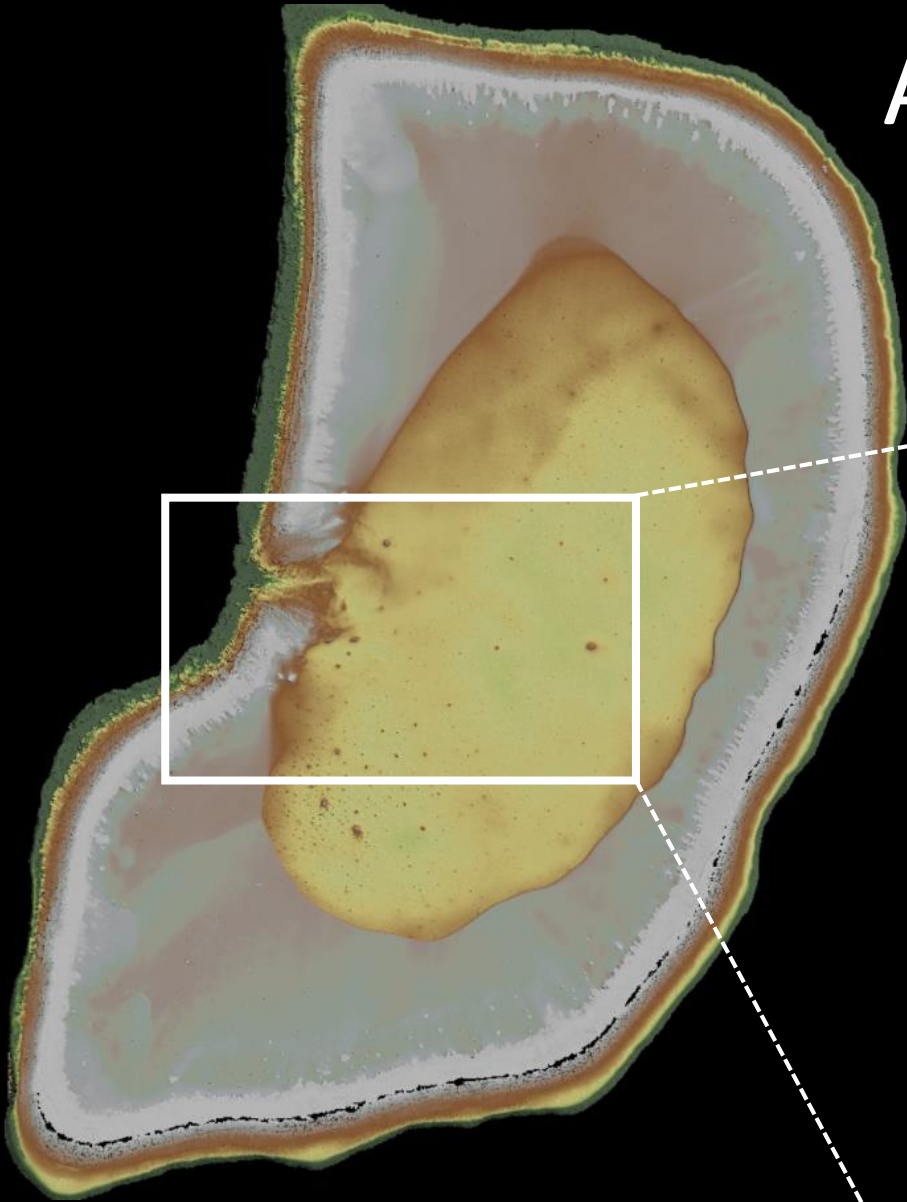
# Satellite-Derived Bathymetry



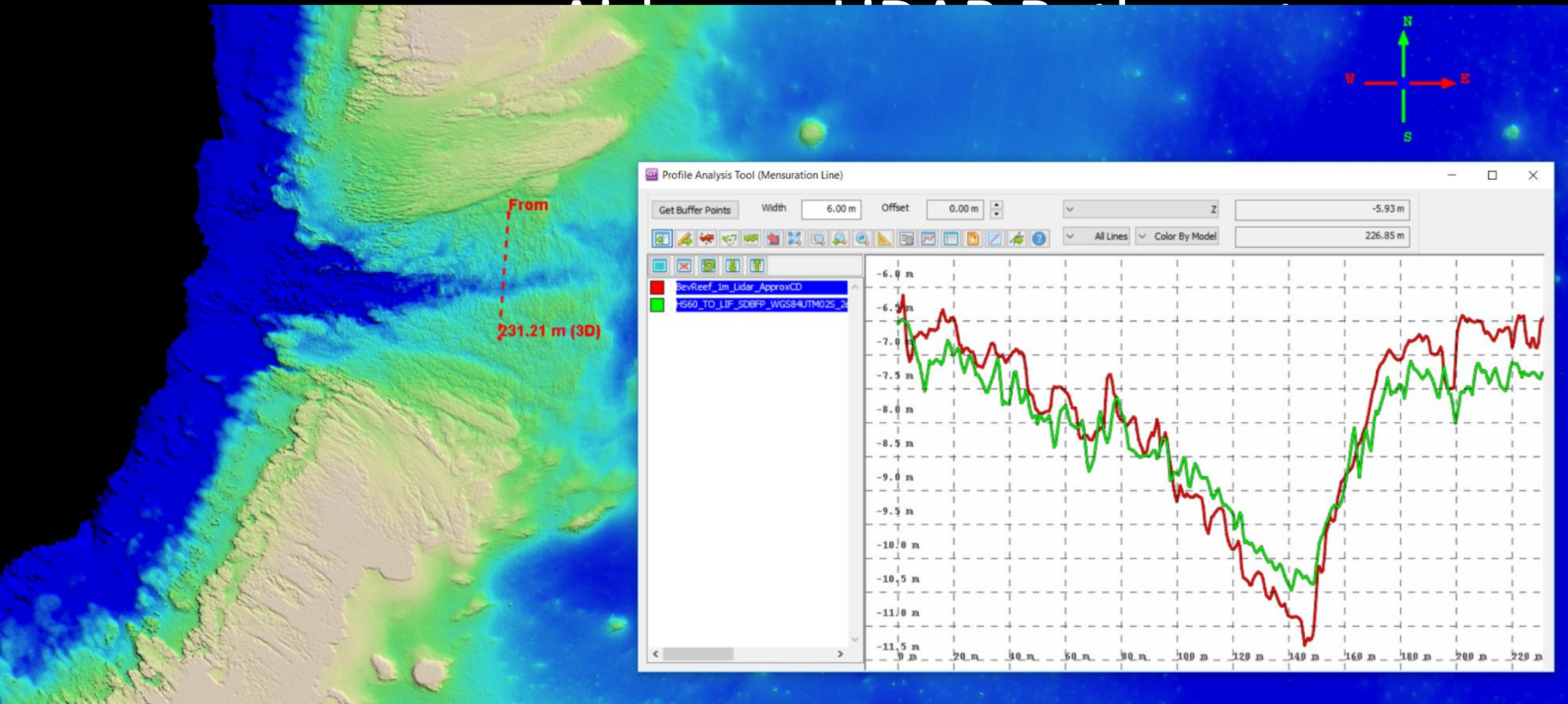


# Airborne LiDAR Bathymetry

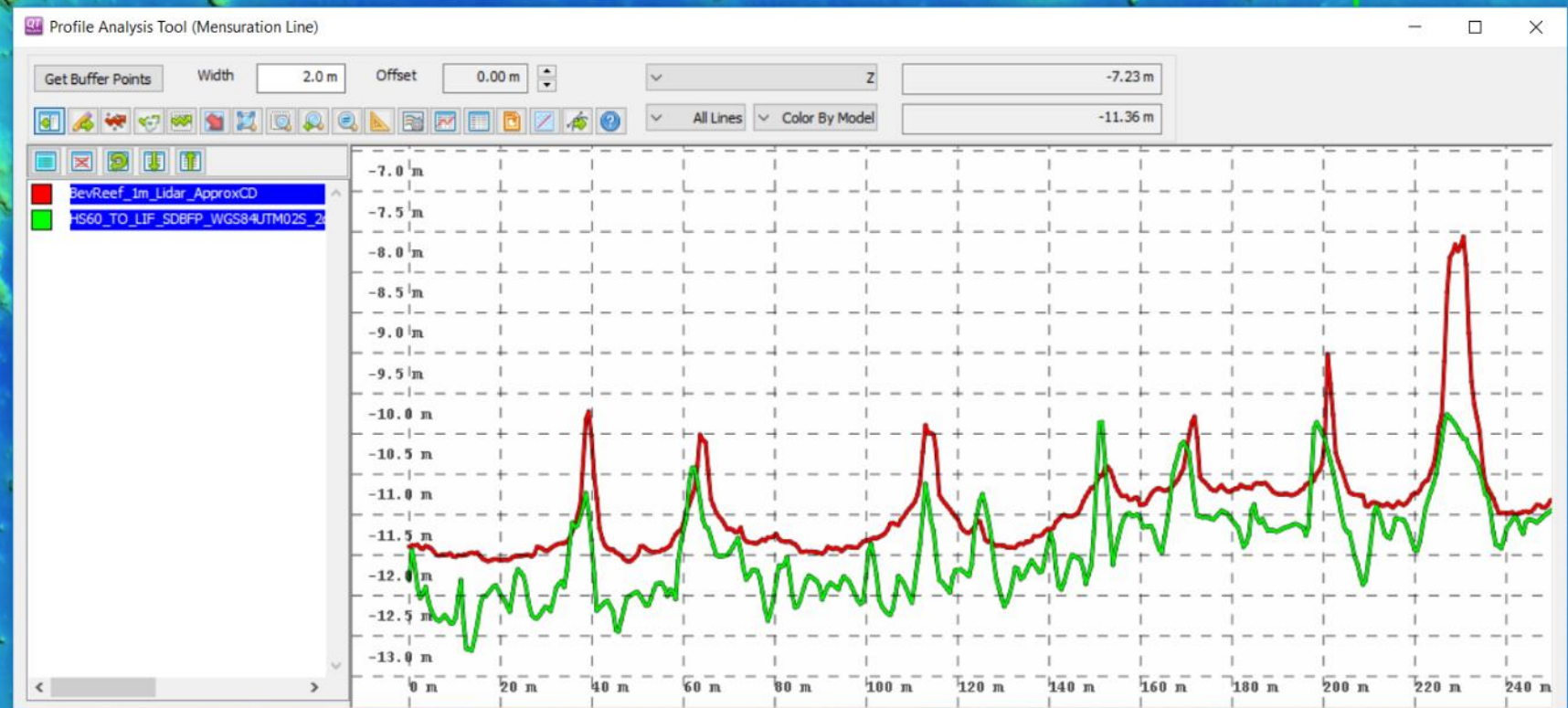
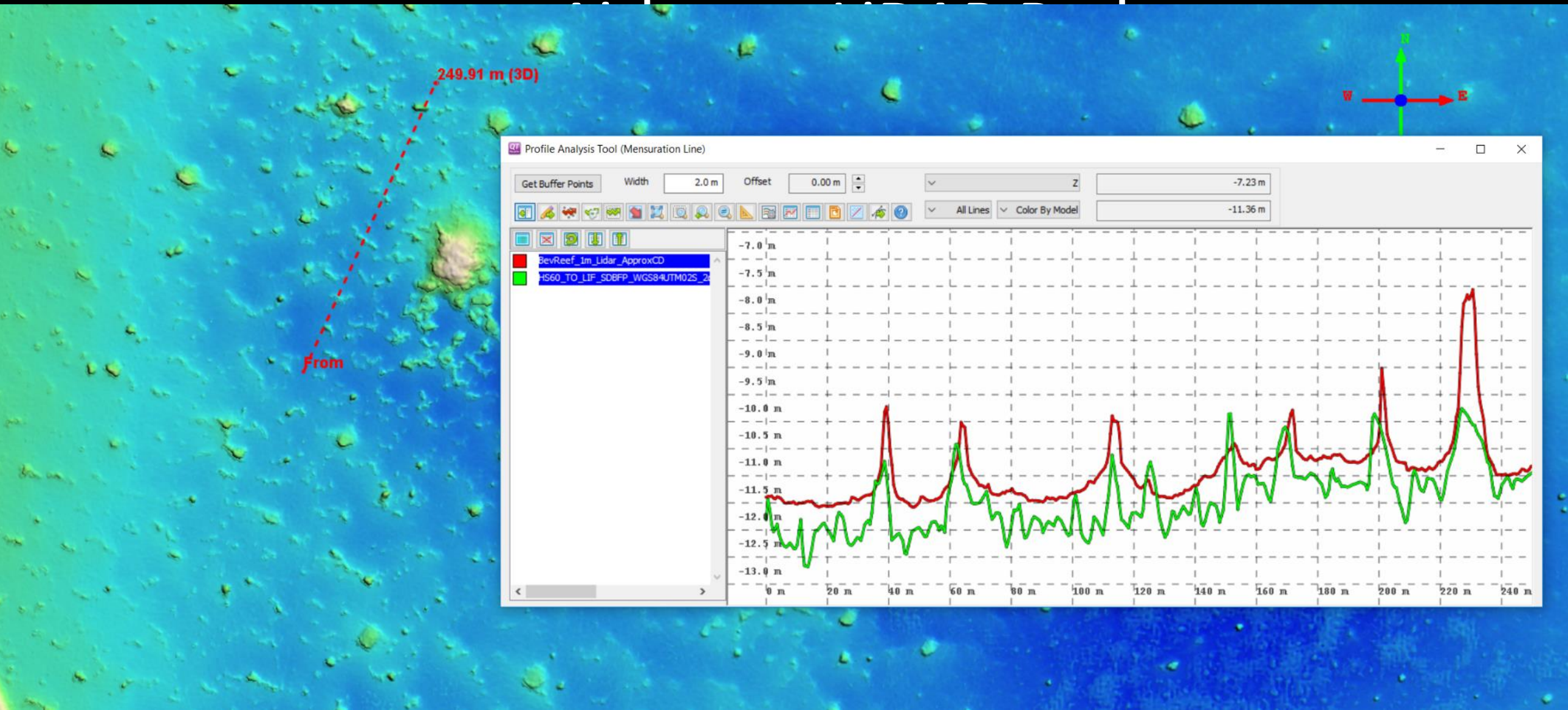
## Beveridge Reef, Niue





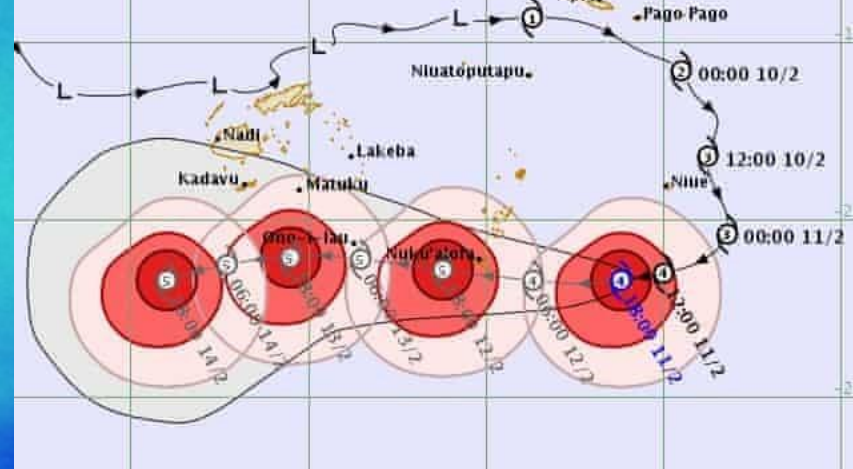




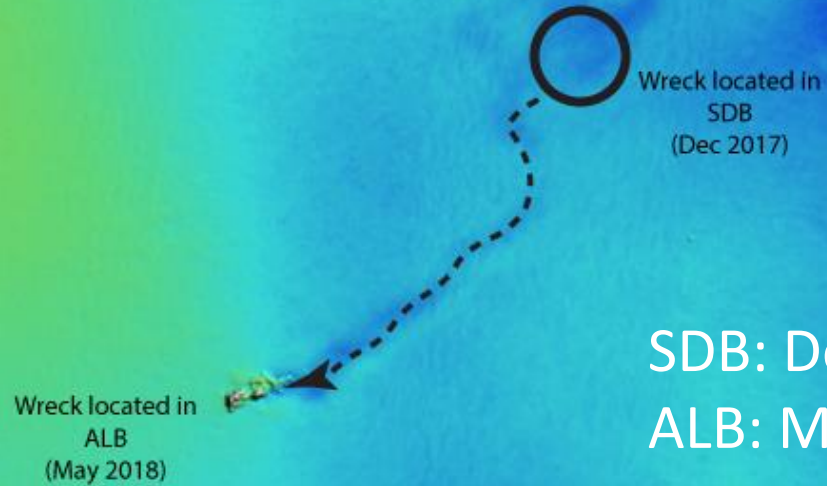




# The case of the missing shipwreck



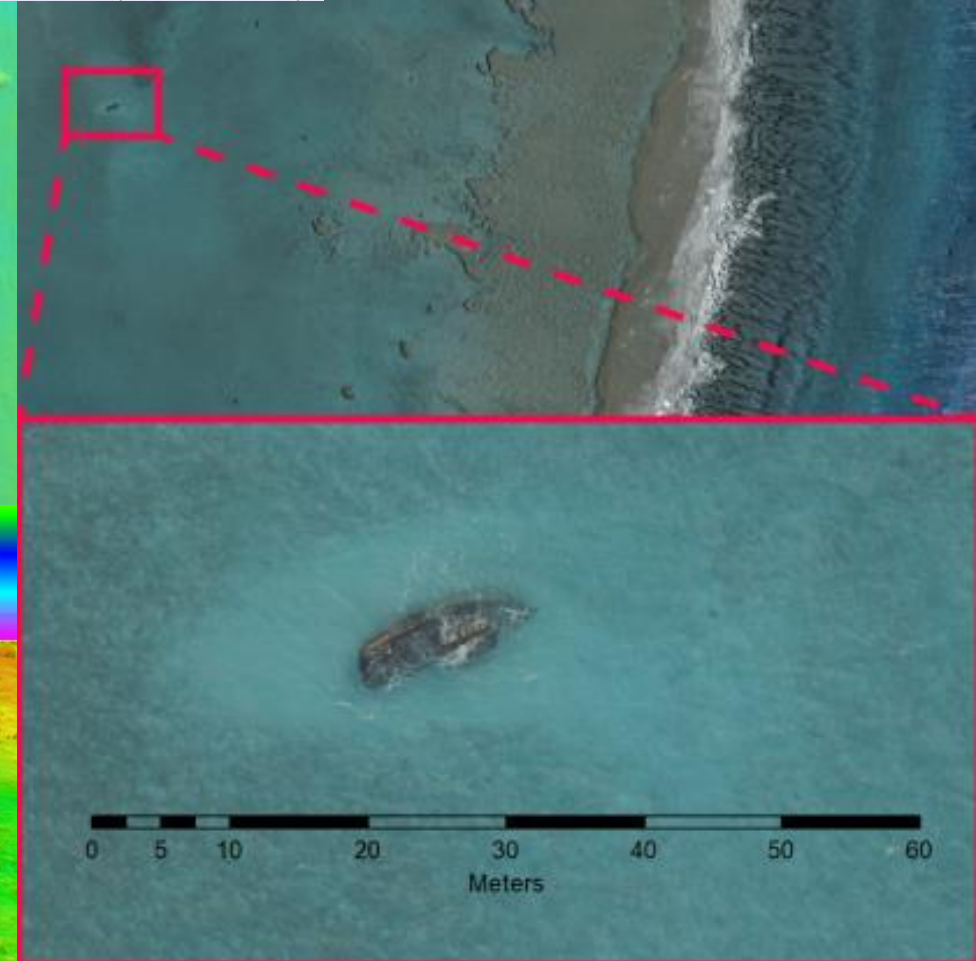
Reef



SDB: Dec 2017  
ALB: May 2018

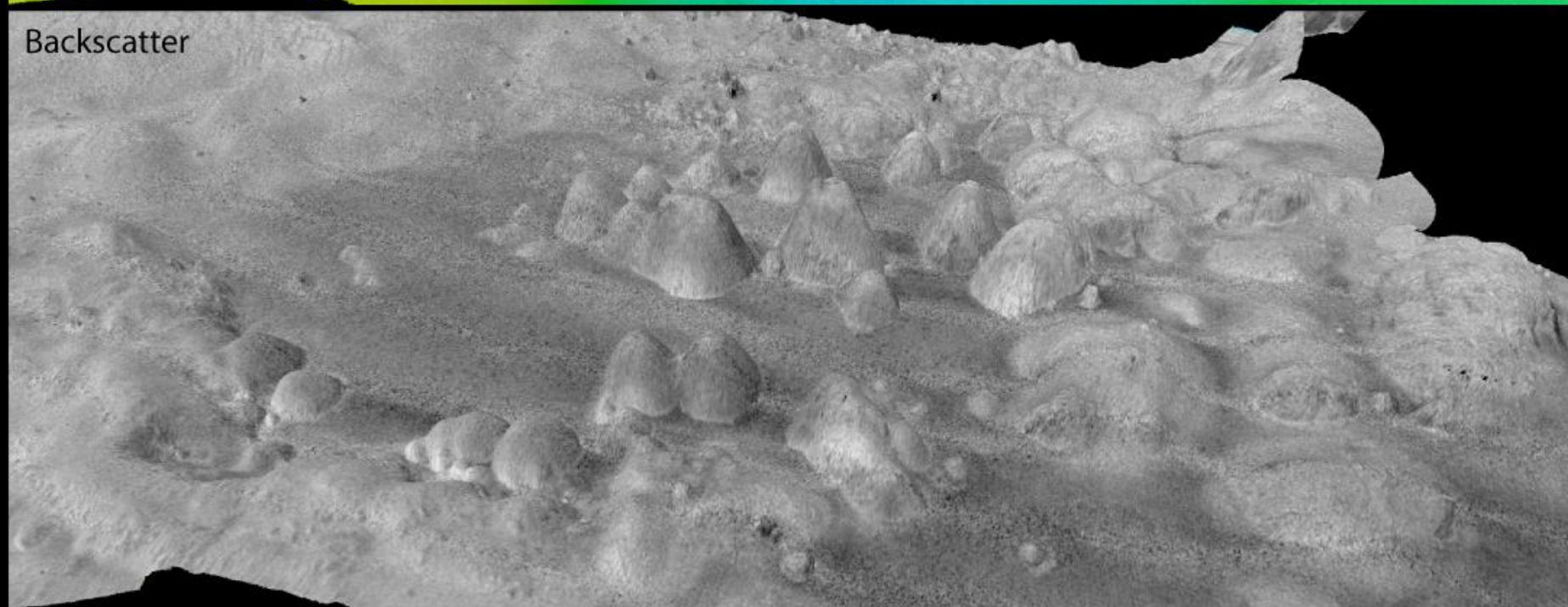
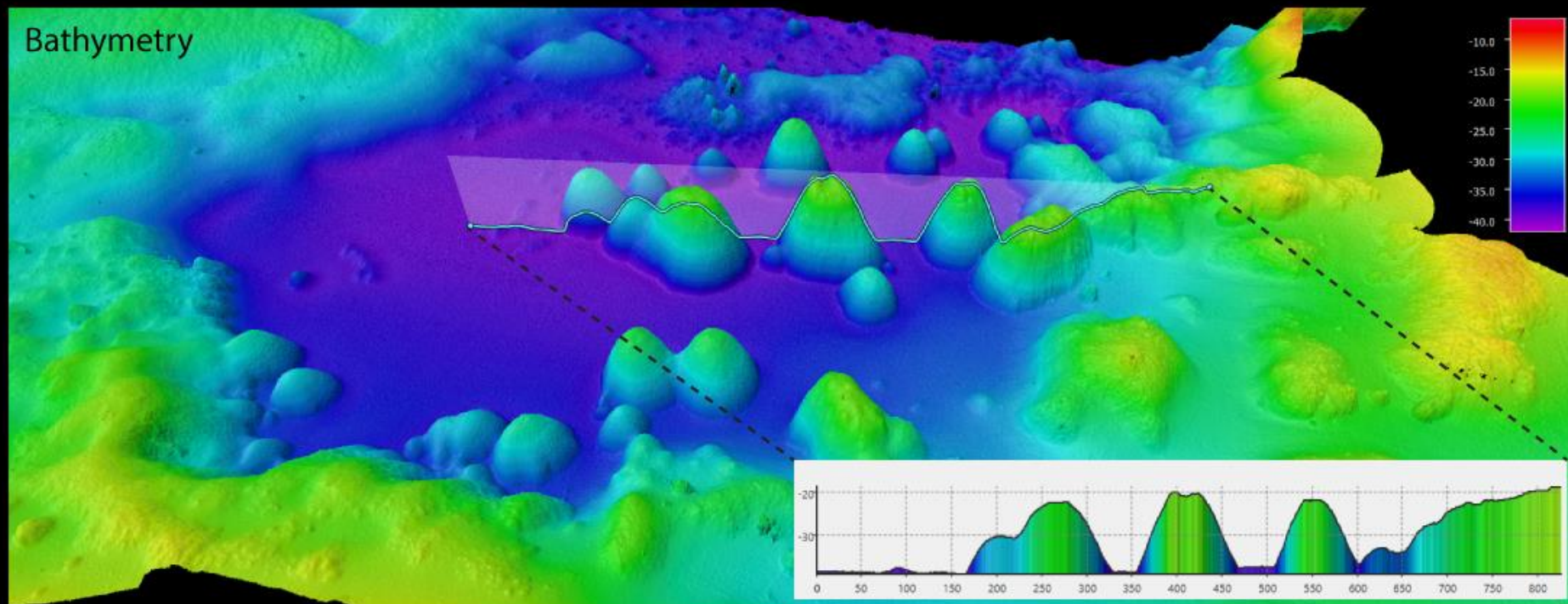
Wreck

ALB points over  
Wreck



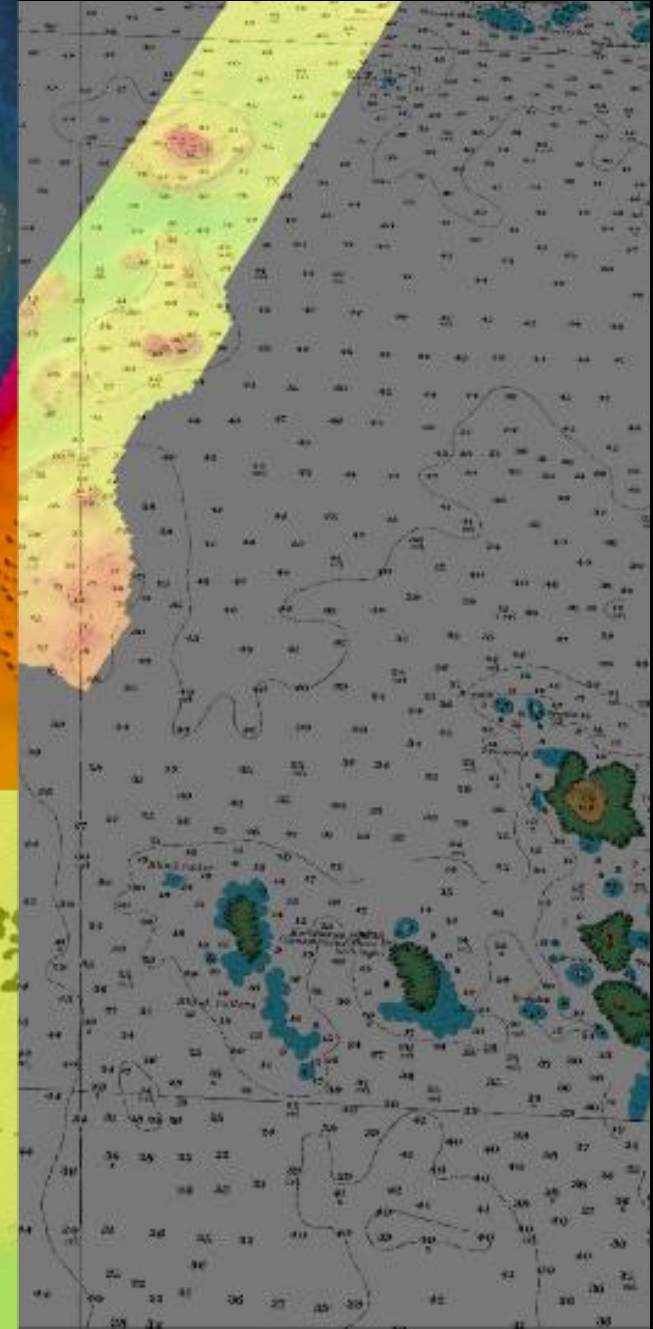
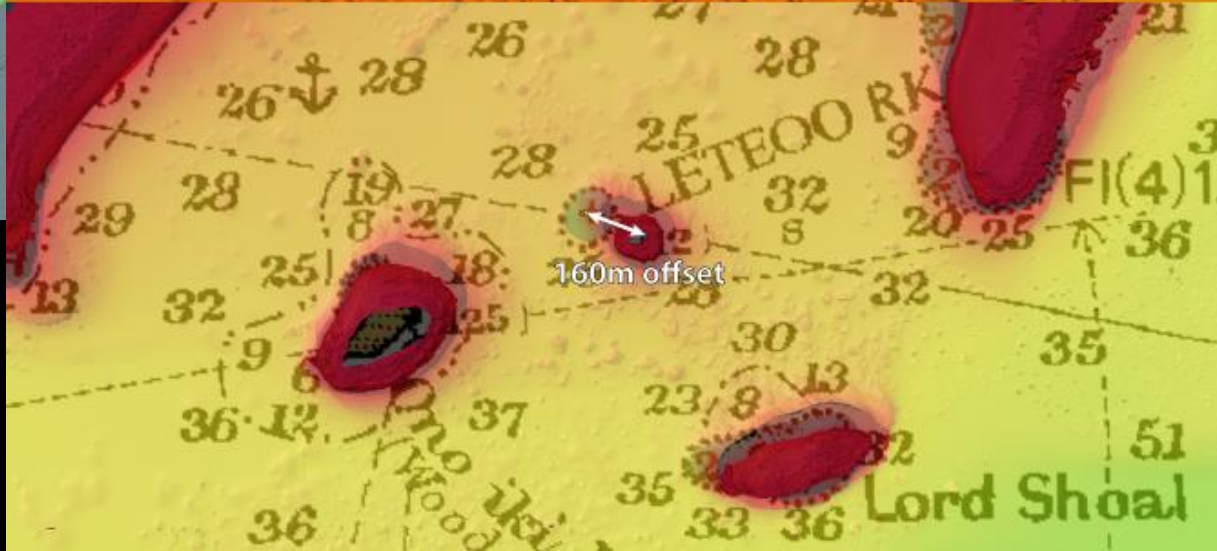
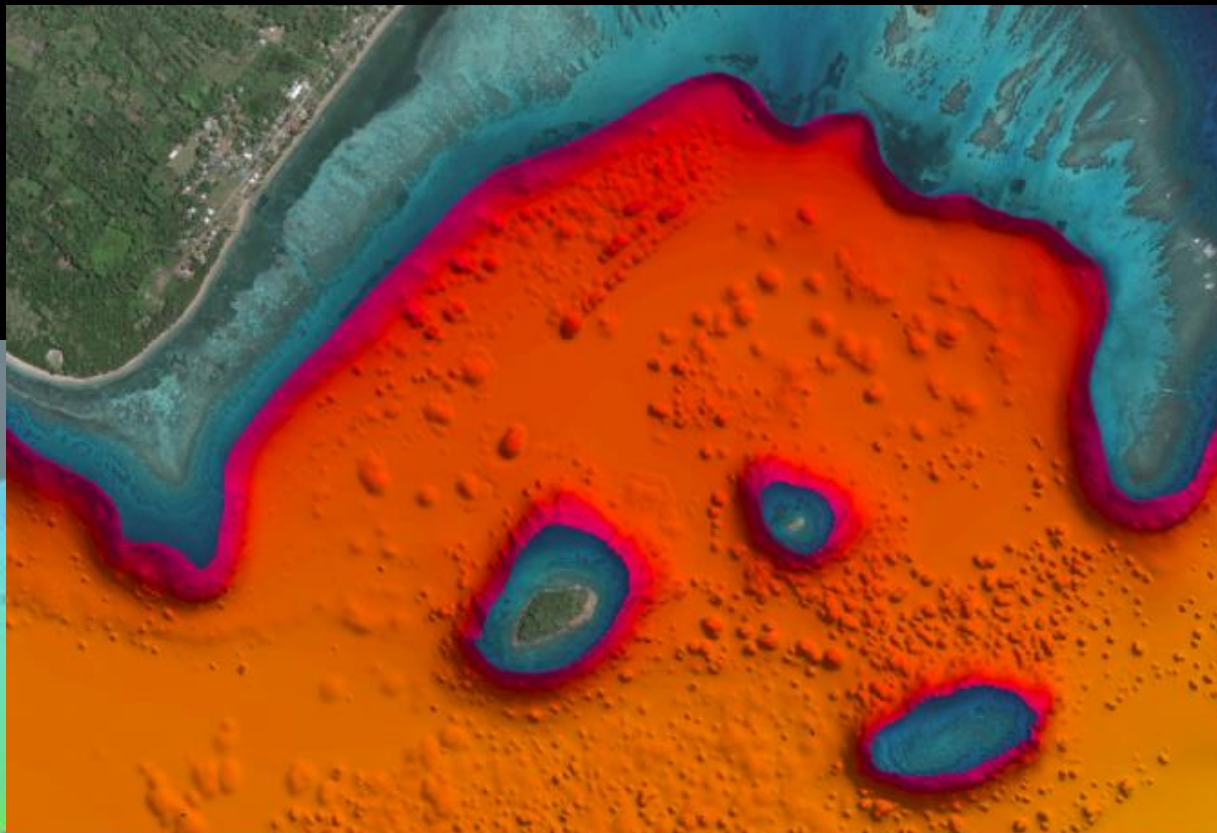
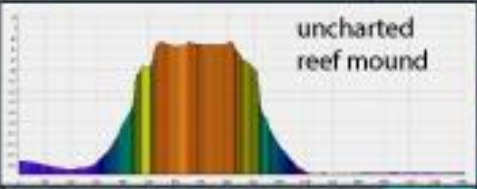


# Multibeam Data



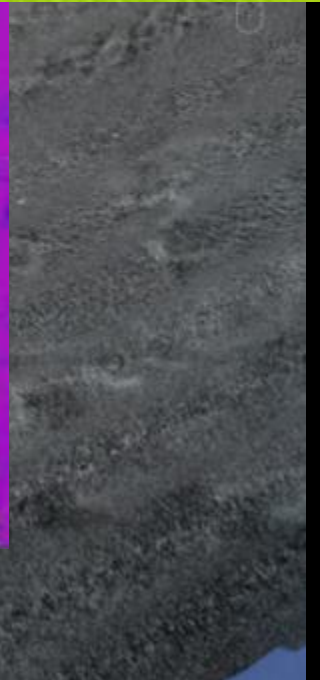
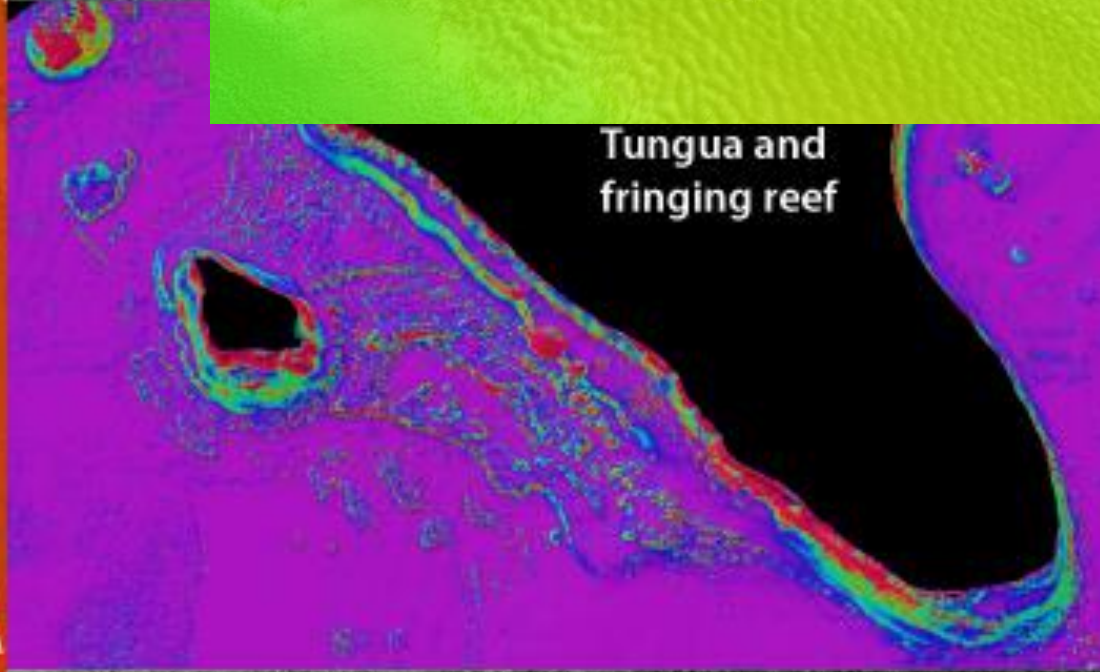
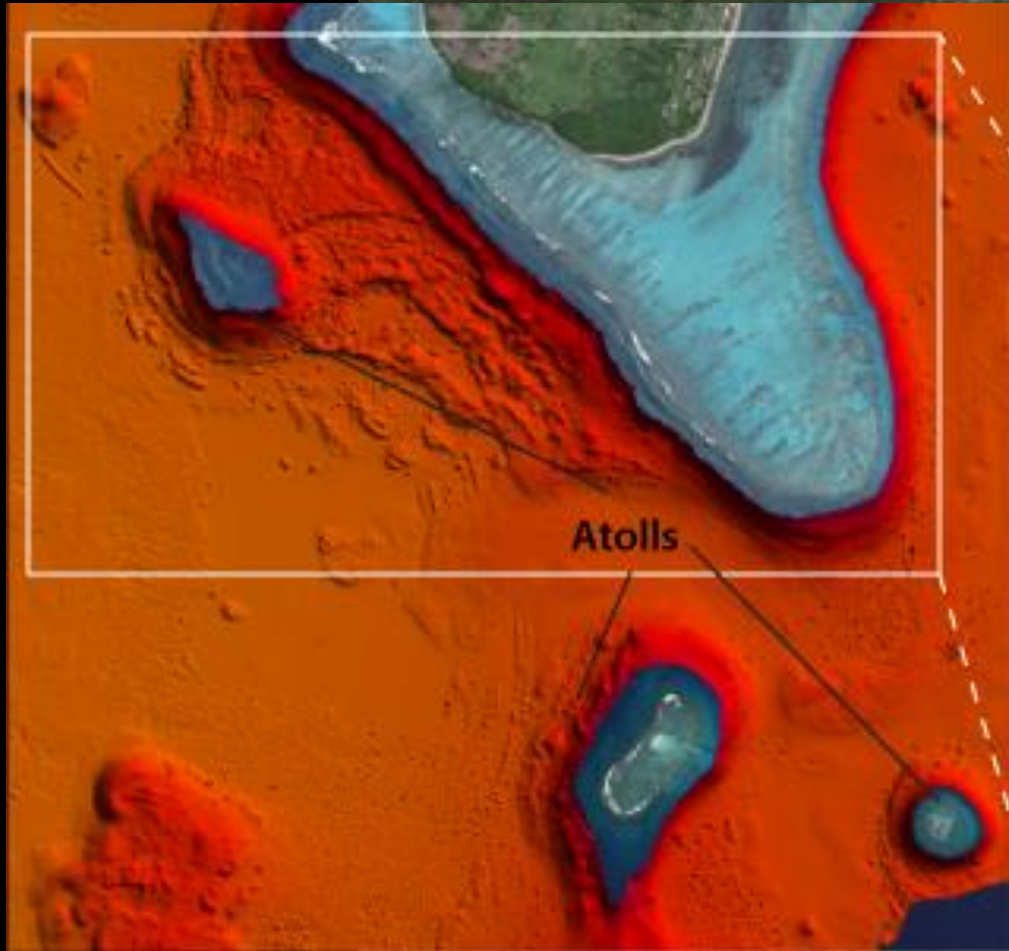
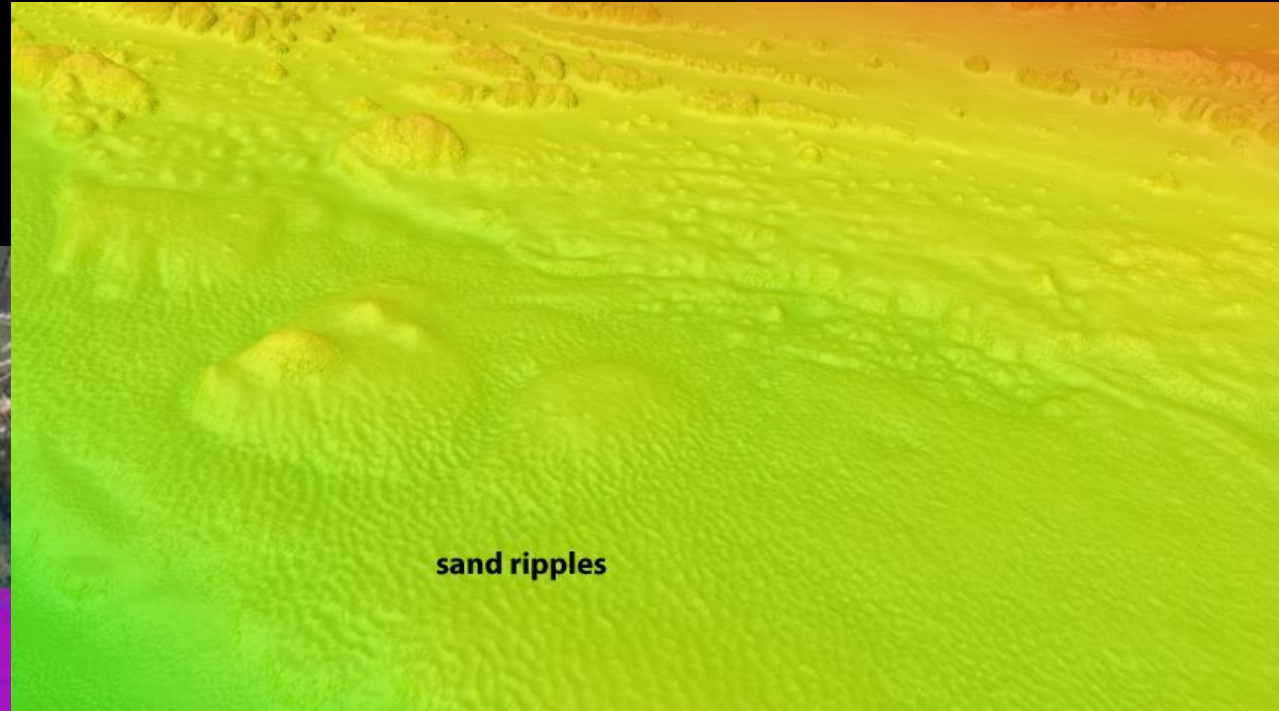
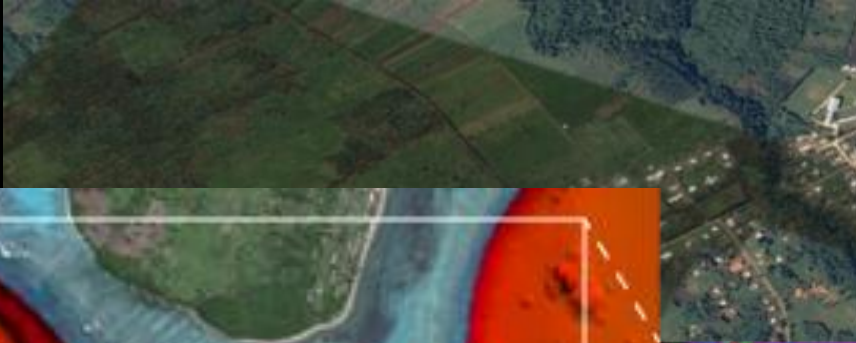


# Multibeam Data

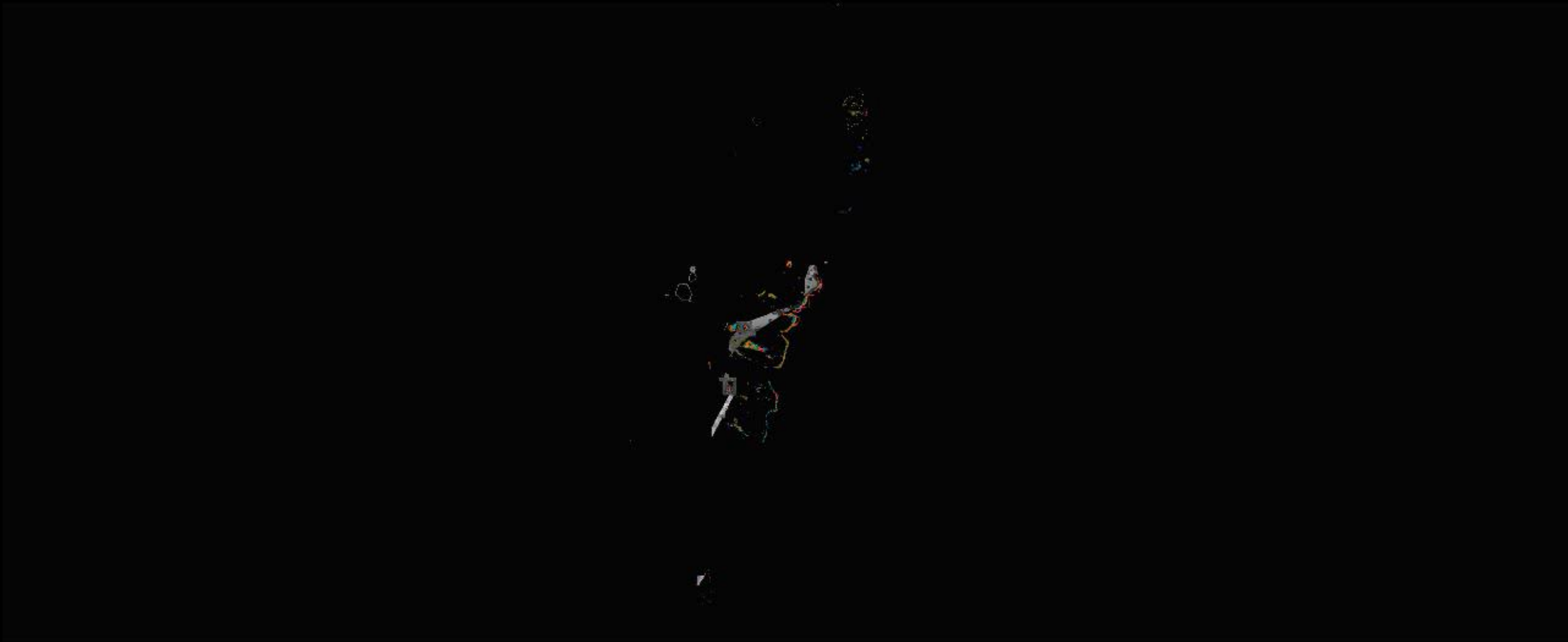




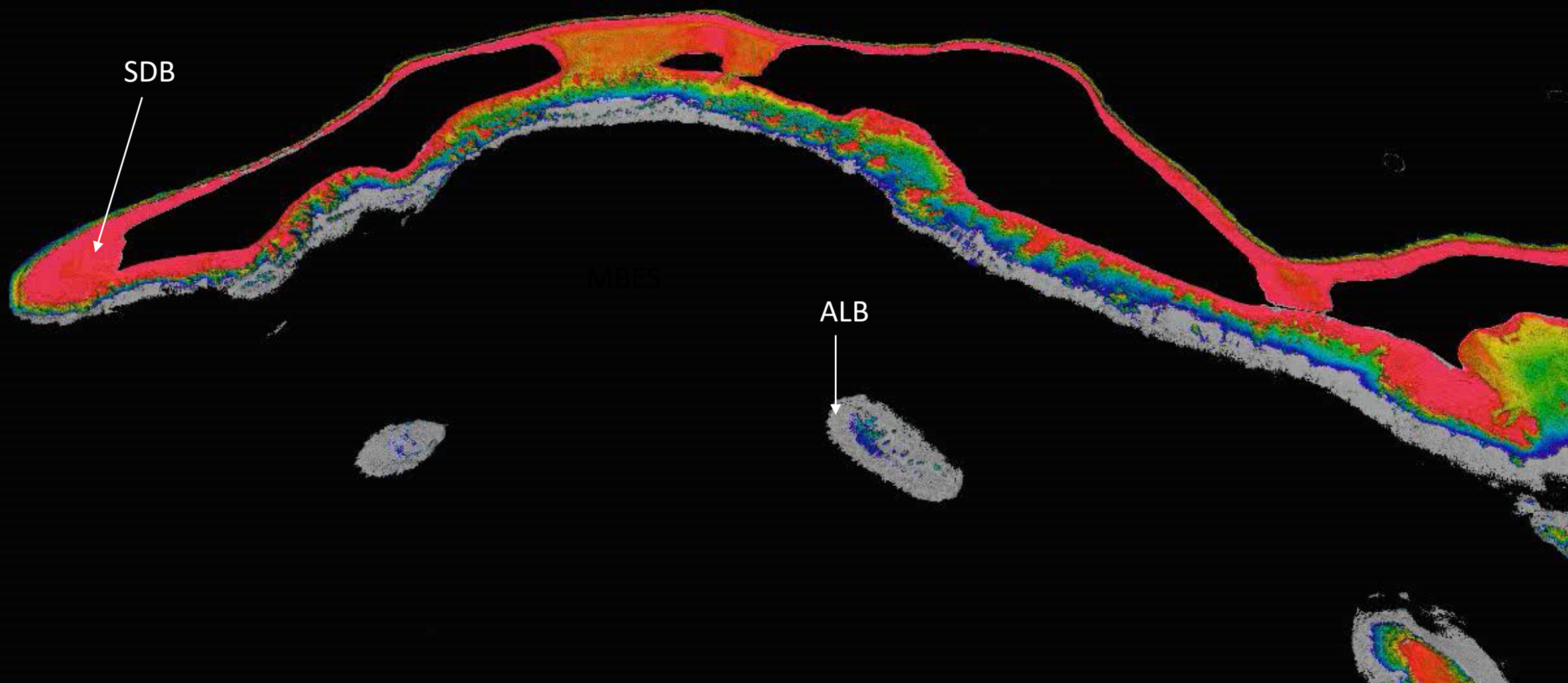
# Multibeam Data







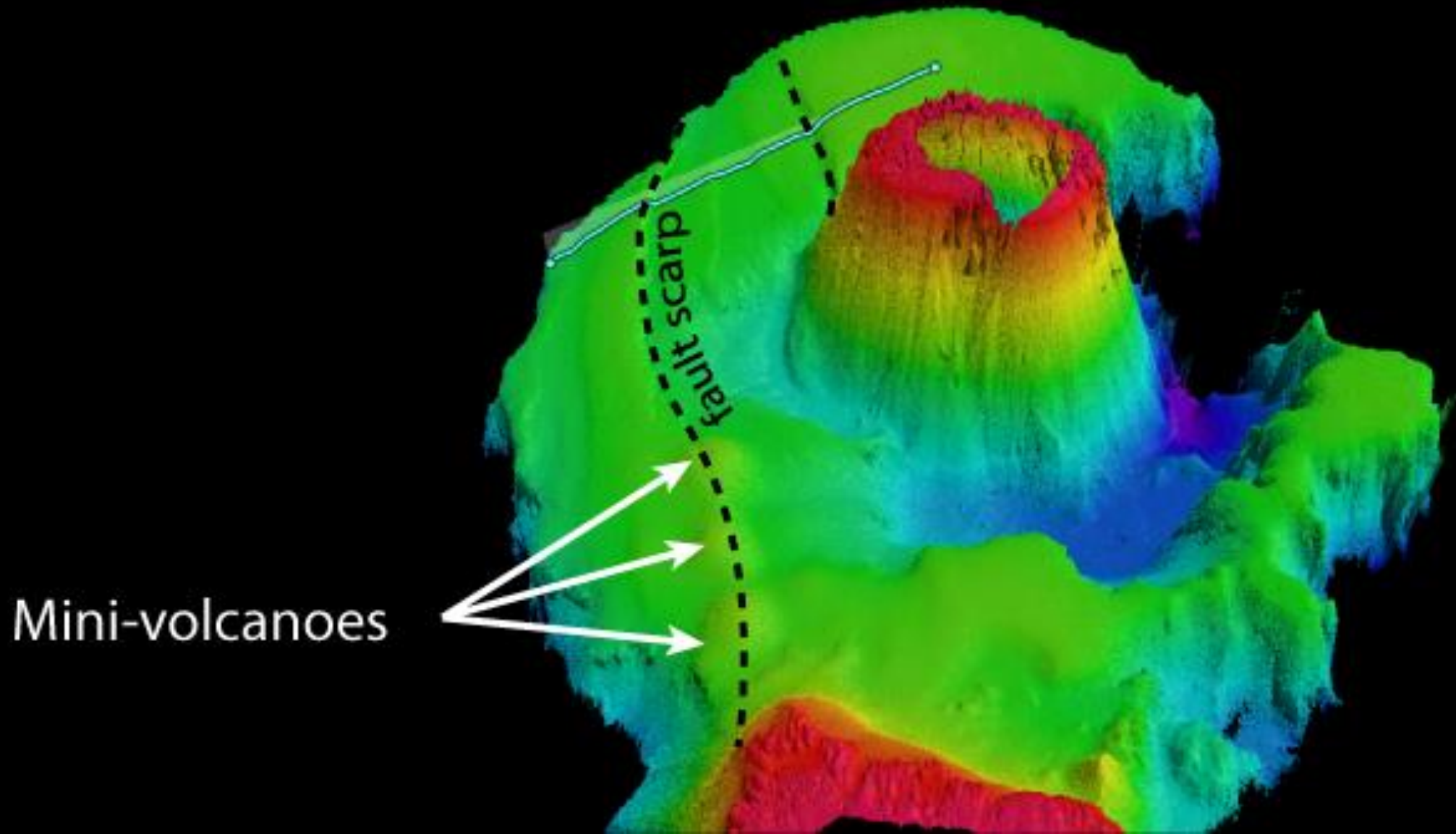




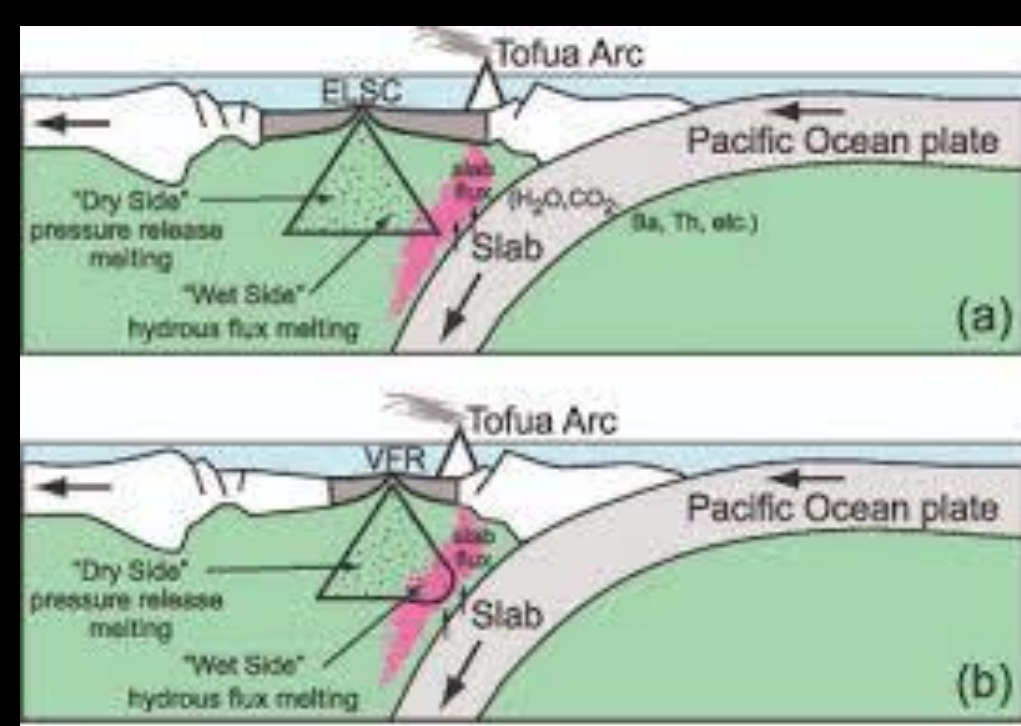
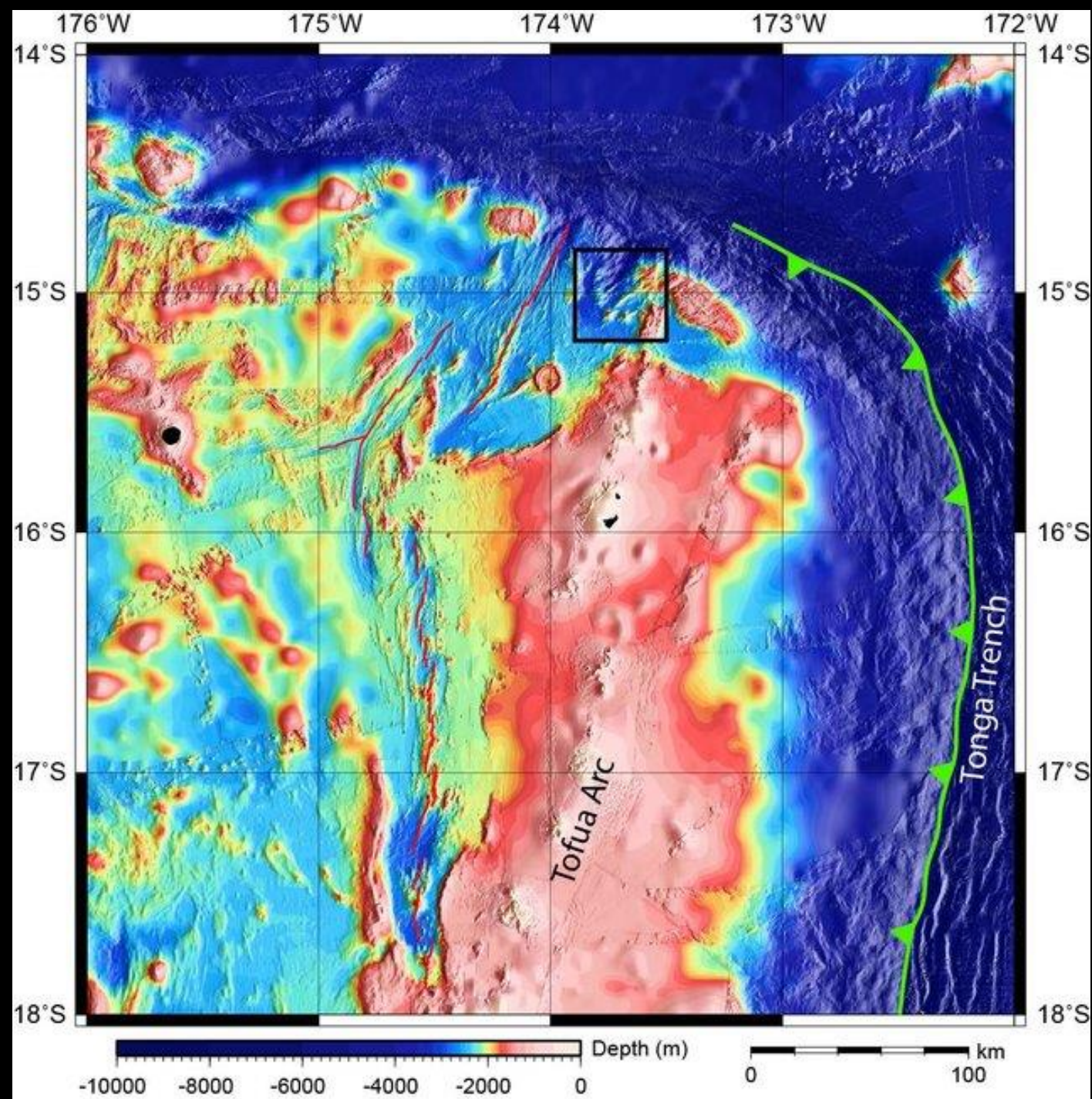


**Tofua**  
Dec 2018

# Underwater Volcanoes









▶ ⏸ 🔊 0:00 / 0:56







Data LDEO-Columbia, NSF, NOAA  
Image © 2019 CNES / Airbus  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

# SDB ~~instead of~~ *along with* MBES to map change

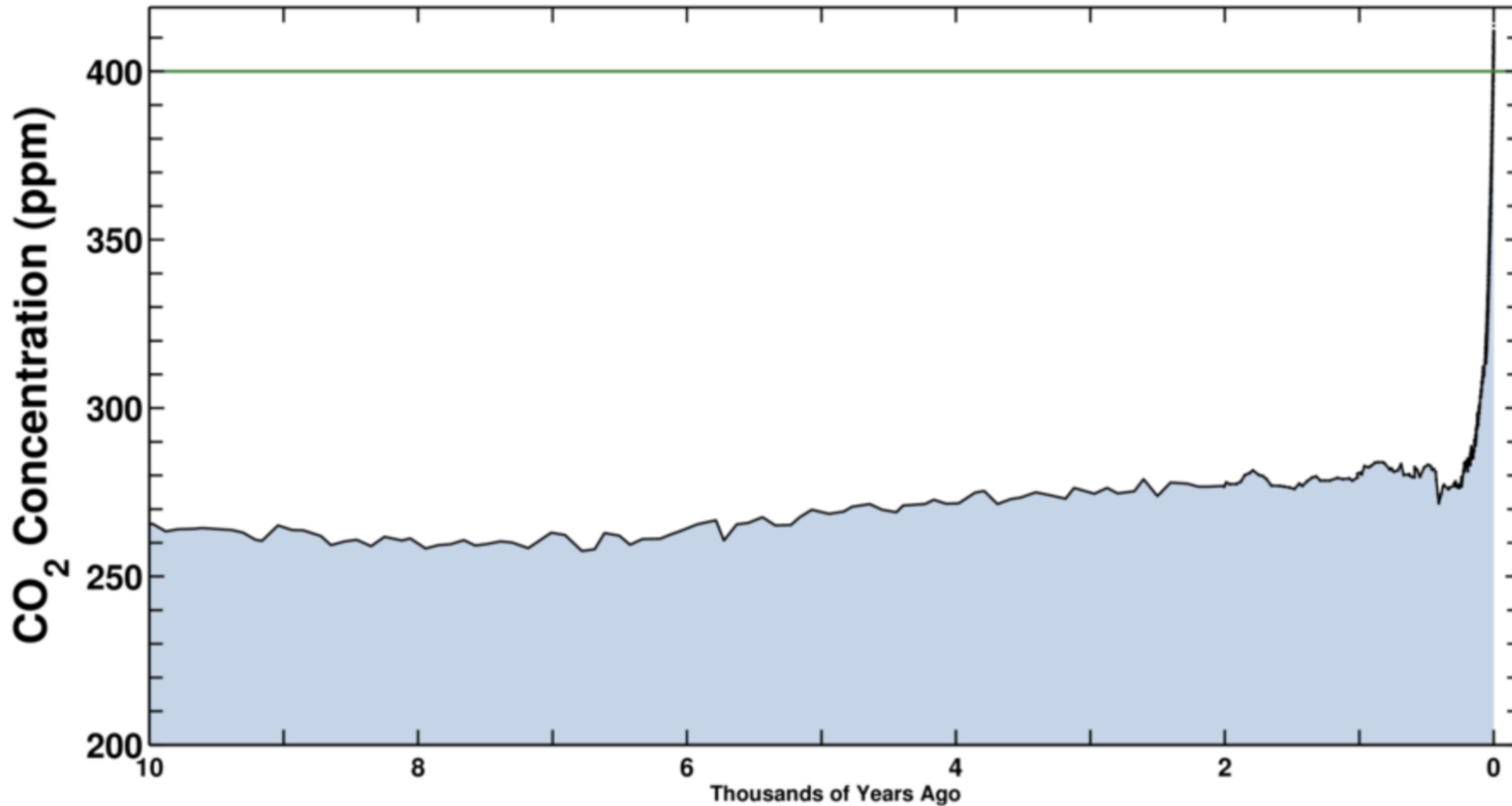
- Overcomes limitations of MBES (cost, depth)
- Cost benefits
- Timeseries analysis of areas isn't realistic for broad areas
- MBES could go in to specific areas to groundtruth



Latest CO<sub>2</sub> reading  
May 11, 2019

415.26 ppm

Ice-core data before 1958. Mauna Loa data after 1958.



# *Shallow Seas are in trouble!*

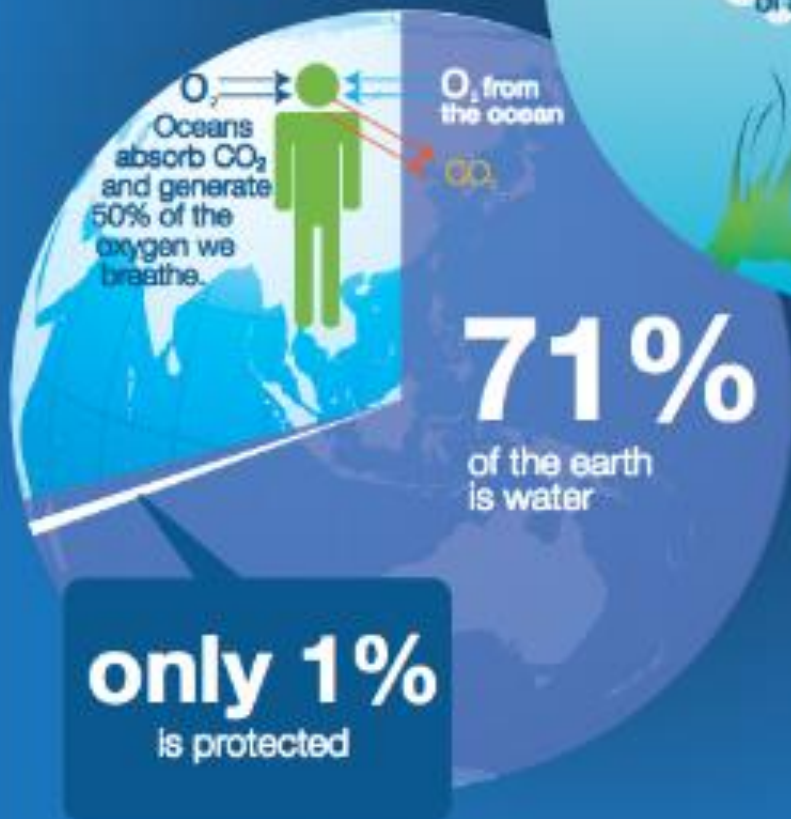
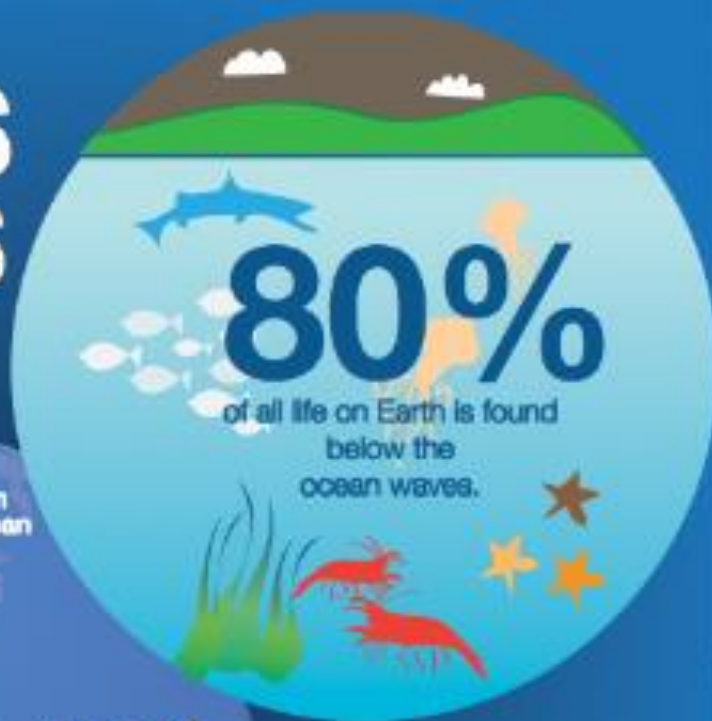
Climate Change is REAL

and it affects the shallows disproportionately

- Sea level rise and shoreline erosion
- Coral bleaching
- Ocean acidification



# OCEANS IN CRISIS



**500  
MILLION  
people**

depend on oceans for  
their livelihoods.



**1 BILLION  
people**

In developing countries  
eat fish as their primary  
source of protein



**76%**

of the world's coral  
species are found in the  
waters of Southeast Asia  
and the Western Pacific.



## *Food for thought.....*

Use SDB to map areas where there might be instability or expected change over time..

How?

Automation: Develop algorithms that detect change automatically!

Note areas of change for further study with other methods.

FOCUS efforts in areas that are important (economically and ecologically)





Land Information  
New Zealand  
*Toitū te whenua*

iXblue



*Questions?*