Satellite Derived Bathymetry

The use of SDB in a multi-sensor approach in the South West Pacific

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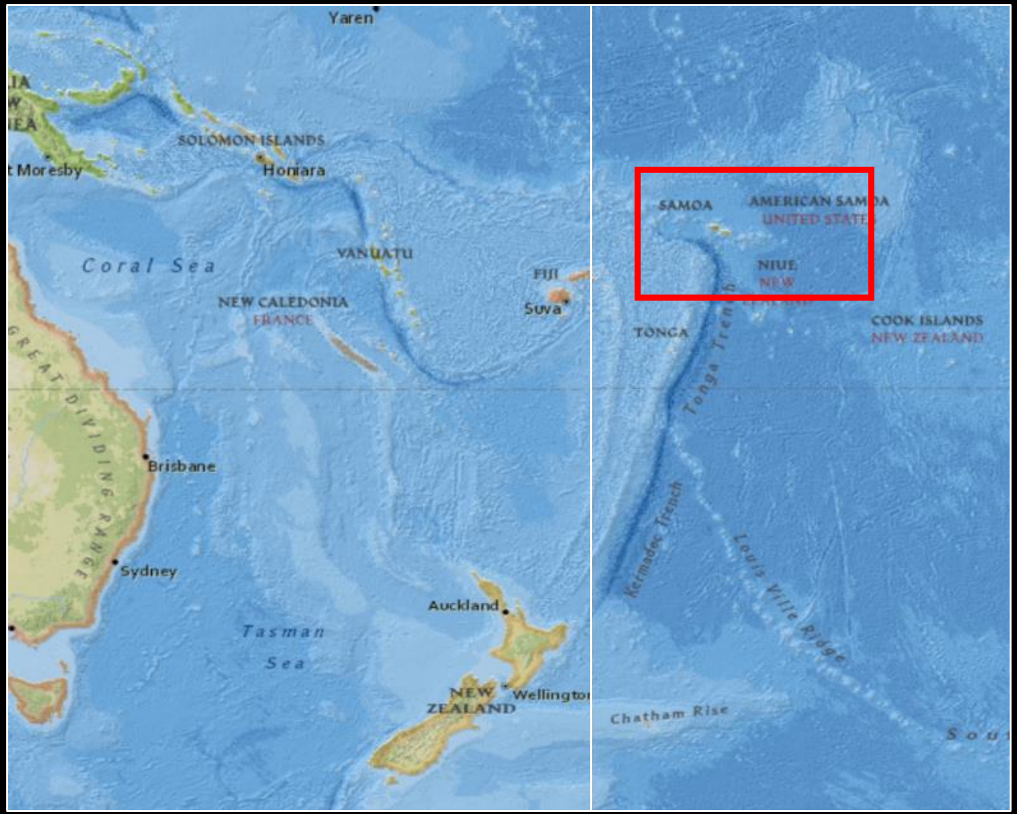
The use of SDB in a multi-sensor approach in the South West Pacific

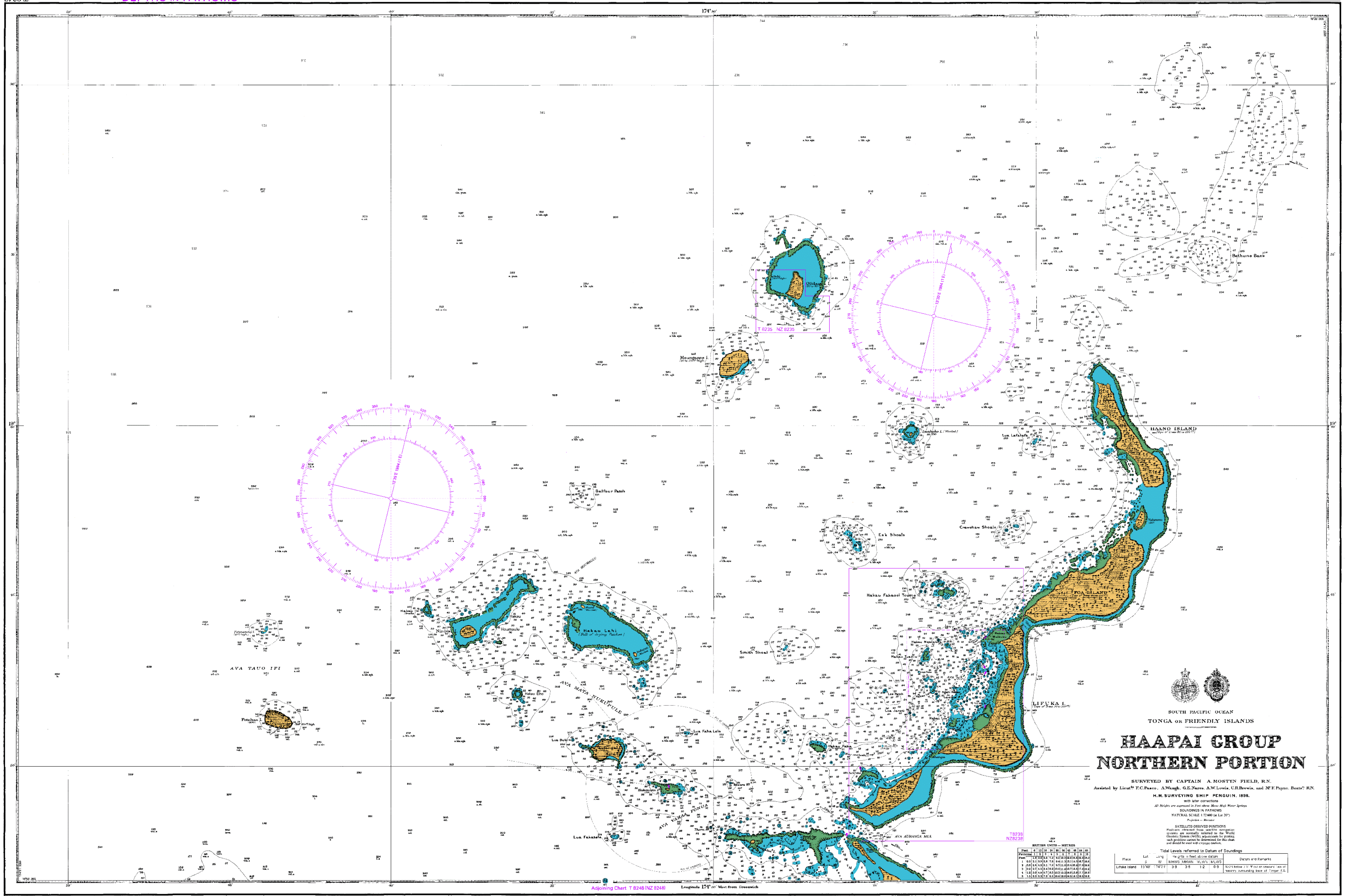
Pacific Regional Navigation Initiative
LINZ HI 60, 61, 62 & 63

- Multi-sensor Approach
  - HS60 (Tonga) SDB, ALB, MBES
  - HS61 (Cook Islands) SDB only
  - HS62 (Niue) SDB and ALB
  - HS63 (Tokelau) SDB only
  - Tide gauge install & datum computations



- Requirement: LINZ-1 Standard (<40m), LINZ-2 (>40m)
- Survey Contractors: EOMAP, Geomatics Data Solutions and iXblue

DEPTHS IN FATHOMS



Place	Lat S	Long W	MHWS	MHWN	MLWN	MLWS	Datum and Remarks
Lifuka Island	19°48'	174°21'	3·9	3·5	1·2	0·9	[illegible]

Published at Auckland, October 1993, by the Hydrographic Office of the Royal New Zealand Navy under the joint superintendence of R.O. Davies, Chief Hydrographer, Tonga and Commander W.D. Frisken, Hydrographer, RNZN.
Reprinted under the authority of Land Information New Zealand.

DEPTHS IN FATHOMS

T 8247
NZ 8247

HMS PENGUIN

Displacement: 1,130 tons

Length: 52m

Beam: 11m

Draft: 4.8m

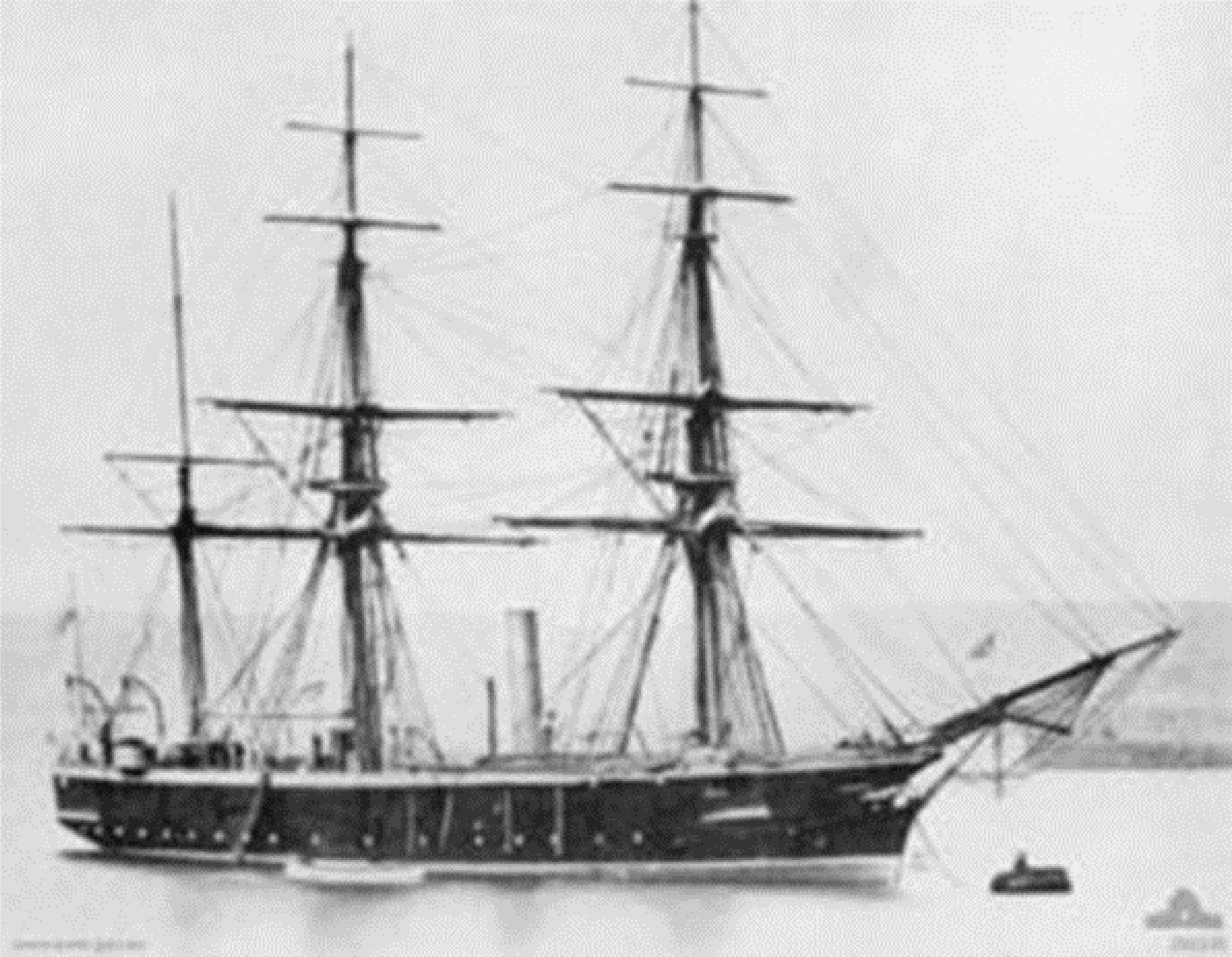
Propulsion: Steam and Sail

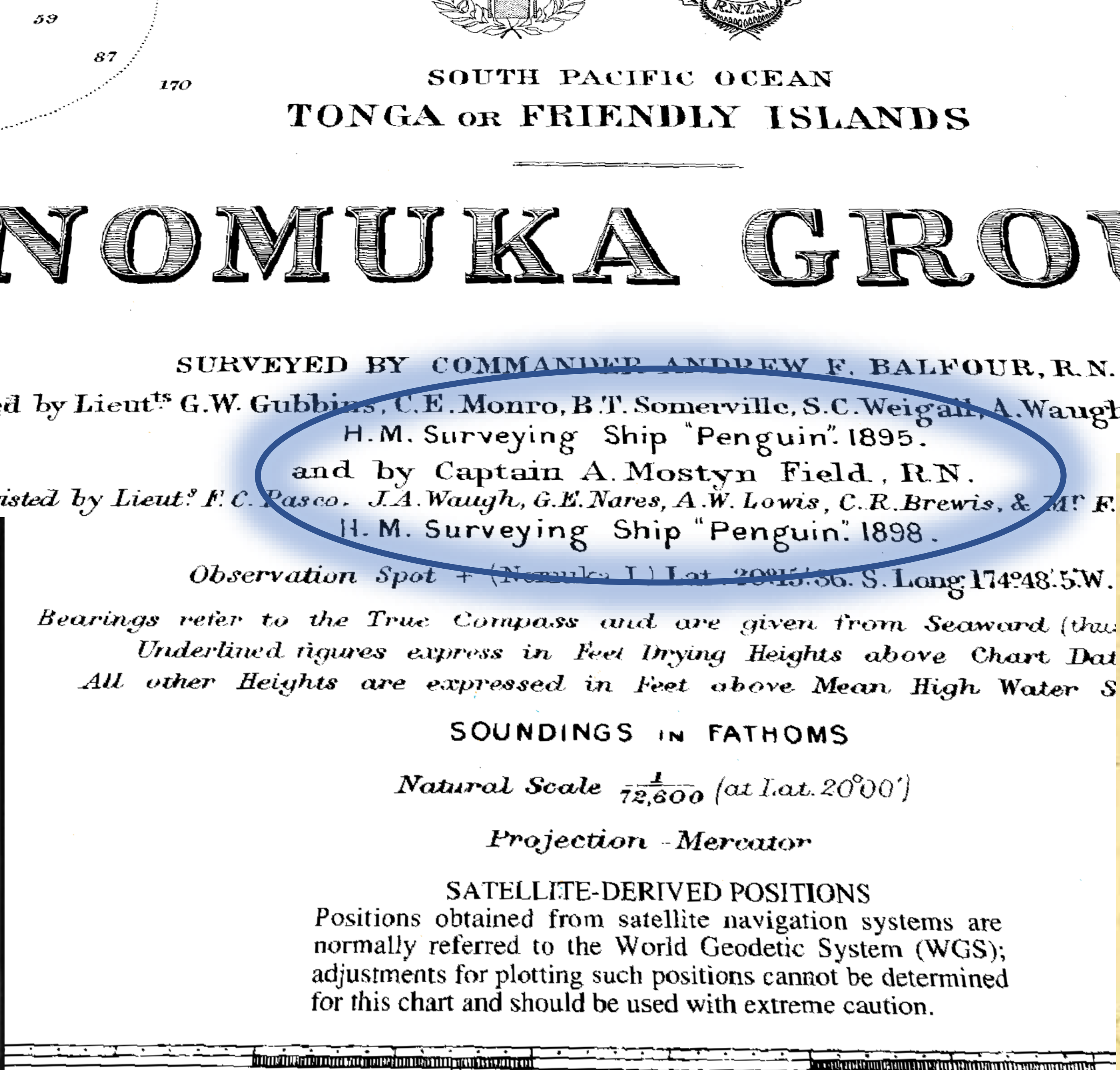
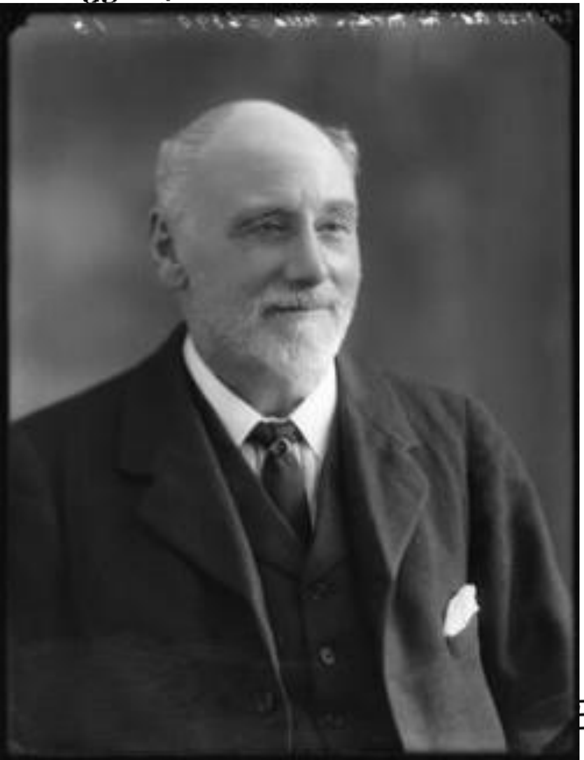
Speed: 10 knots

Range: 1,480nm

Compliment: 150

Broken up and burnt on 13 December 1960 at Kerosene Bay, Sydney.




SOUTH PACIFIC OCEAN
TONGA OR FRIENDLY ISLANDS
NOMUKA GROUP
SURVEYED BY COMMANDER ANDREW F. BALFOUR, R.N.
Assisted by Lieut[ts] G.W. Gubbins, C.E. Monro, B.T. Somerville, S.C. Weigall, A. Waugh, & M[r] T. Rice, R.N.
H.M. Surveying Ship "Penguin". 1895.
and by Captain A. Mostyn Field, R.N.
assisted by Lieut[s] F.C. Pasco, J.A. Waugh, G.E. Nares, A.W. Lowis, C.R. Brewis, & M[r] F.
H.M. Surveying Ship "Penguin". 1898.
Observation Spot + (Nomuka I.) Lat. 20°15'36. S. Long 174°48'.5 W.
Bearings refer to the True Compass and are given from Seaward
Underlined figures express in Feet Drying Heights above Chart Dat
All other Heights are expressed in Feet above Mean High Water S
SOUNDINGS IN FATHOMS
Natural Scale 1/72,600 (at Lat. 20°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.


A. Mostyn Field

Depth Measurement 1895-98

Lead lines. Ropes with lead on one end.

Soundings generally accurate, coverage between single depths was lacking. (echosounders/fathometers) not invented until 1913.

Position Measurement

Position measurement – Marine Sextant

Accurate when you could fix on shoreline feature, less the further offshore the survey.

10 minutes to shoot, reduce and plot

Minimum 3 heavenly bodies needed for a visual fix.

OK at night, impossible during the day

Positioning was slow and inaccurate by todays standards

Time measurement 1895-98

- Celestial Navigation relied upon time for accurate positioning.

Survey Standards

IHO STANDARDS FOR HYDROGRAPHIC SURVEYS (S-44)
5th Edition February 2008

TABLE 1
Minimum Standards for Hydrographic Surveys
(To be read in conjunction with the full text set out in this document.)

Reference	Order	Special	1a	1b	2
Chapter 1	**Description of areas.**	Areas where under-keel clearance is critical	Areas shallower than 100 metres where under-keel clearance is less critical but *features* of concern to surface shipping may exist.	Areas shallower than 100 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.
Chapter 2	**Maximum allowable THU 95% *Confidence level***	2 metres	5 metres + 5% of depth	5 metres + 5% of depth	20 metres + 10% of depth
Para 3.2 and note 1	**Maximum allowable TVU 95% *Confidence level***	a = 0.25 metre b = 0.0075	a = 0.5 metre b = 0.013	a = 0.5 metre b = 0.013	a = 1.0 metre b = 0.023
Glossary and note 2	***Full Sea floor Search***	Required	Required	Not required	Not required
Para 2.1 Para 3.4 Para 3.5 and note 3	***Feature Detection***	Cubic *features* > 1 metre	Cubic *features* > 2 metres, in depths up to 40 metres; 10% of depth beyond 40 metres	Not Applicable	Not Applicable
Para 3.6 and note 4	**Recommended maximum Line Spacing**	Not defined as *full sea floor search* is required	Not defined as *full sea floor search* is required	3 x average depth or 25 metres, whichever is greater For bathymetric lidar a spot spacing of 5 x 5 metres	4 x average depth
Chapter 2 and note 5	**Positioning of fixed aids to navigation and topography significant to navigation. (95% *Confidence level*)**	2 metres	2 metres	2 metres	5 metres
Chapter 2 and note 5	**Positioning of the Coastline and topography less significant to navigation (95% *Confidence level*)**	10 metres	20 metres	20 metres	20 metres
Chapter 2 and note 5	**Mean position of floating aids to navigation (95% *Confidence level*)**	10 metres	10 metres	10 metres	20 metres

Charting Standards

ZOC CATEGORIES

(For details see Australian Notice to Mariners No 25)

ZOC	POSITION ACCURACY	DEPTH ACCURACY	SEAFLOOR COVERAGE
A1	±5m	±0.50m + 1%d	All significant seafloor features detected.
A2	±20m	±1.00m + 2%d	All significant seafloor features detected.
B	±50m	±1.00m + 2%d	Uncharted features hazardous to surface navigation are not expected but may exist.
C	±500m	±2.00m + 5%d	Depth anomalies may be expected.
D	Worse than ZOC C	Worse than ZOC C	Large depth anomalies may be expected.
U	Unassessed - The quality of the bathymetric data has yet to be assessed.		
MDSC	Maintained Depth See Chart.		

Summary

Why the SW Pacific needs modern charts

History Lesson Over!

Pacific Regional Navigation Initiative (PRNI)

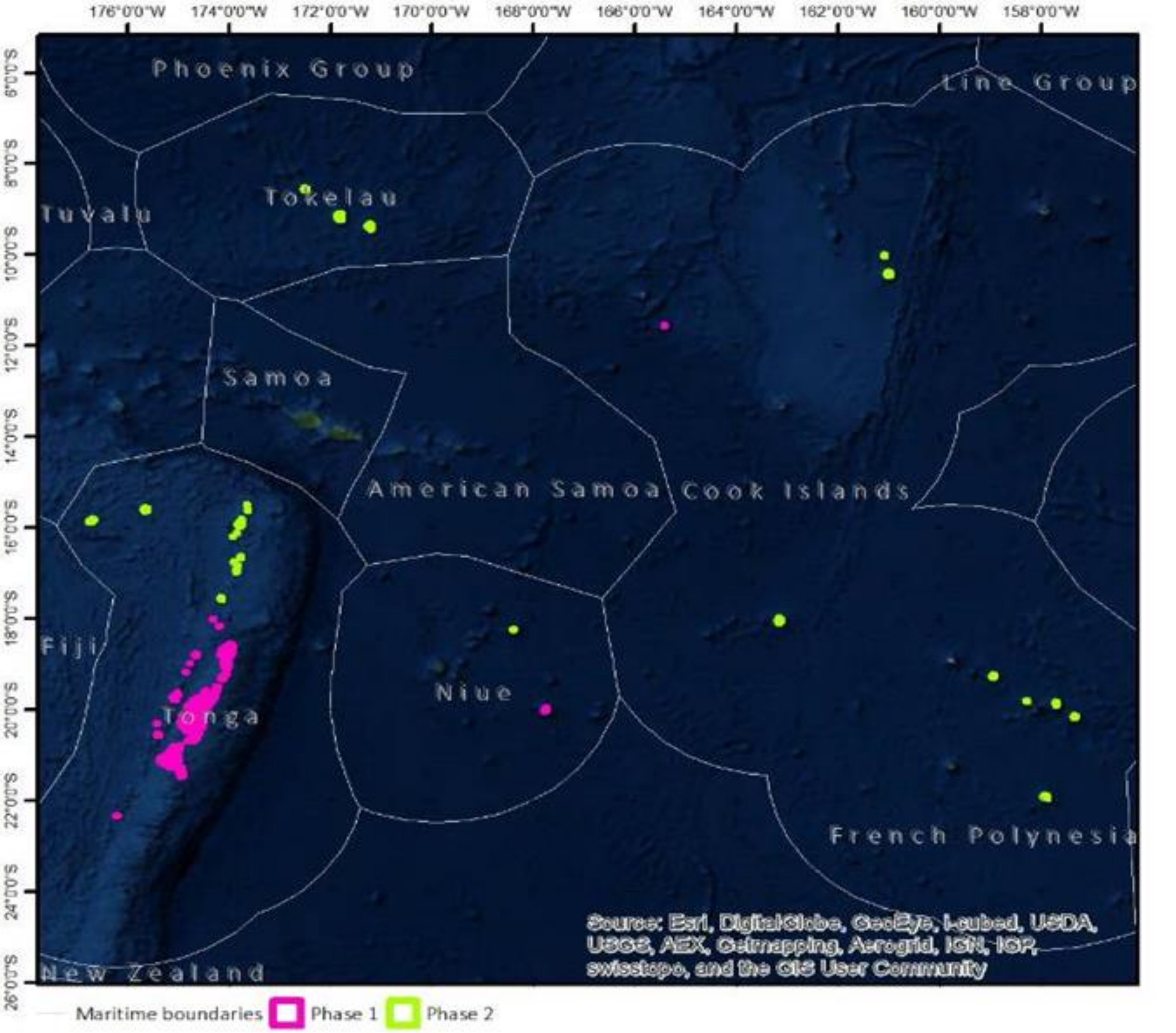
So much to survey

So little funding

Sensor Type #1

Satellite Derived

Bathymetry

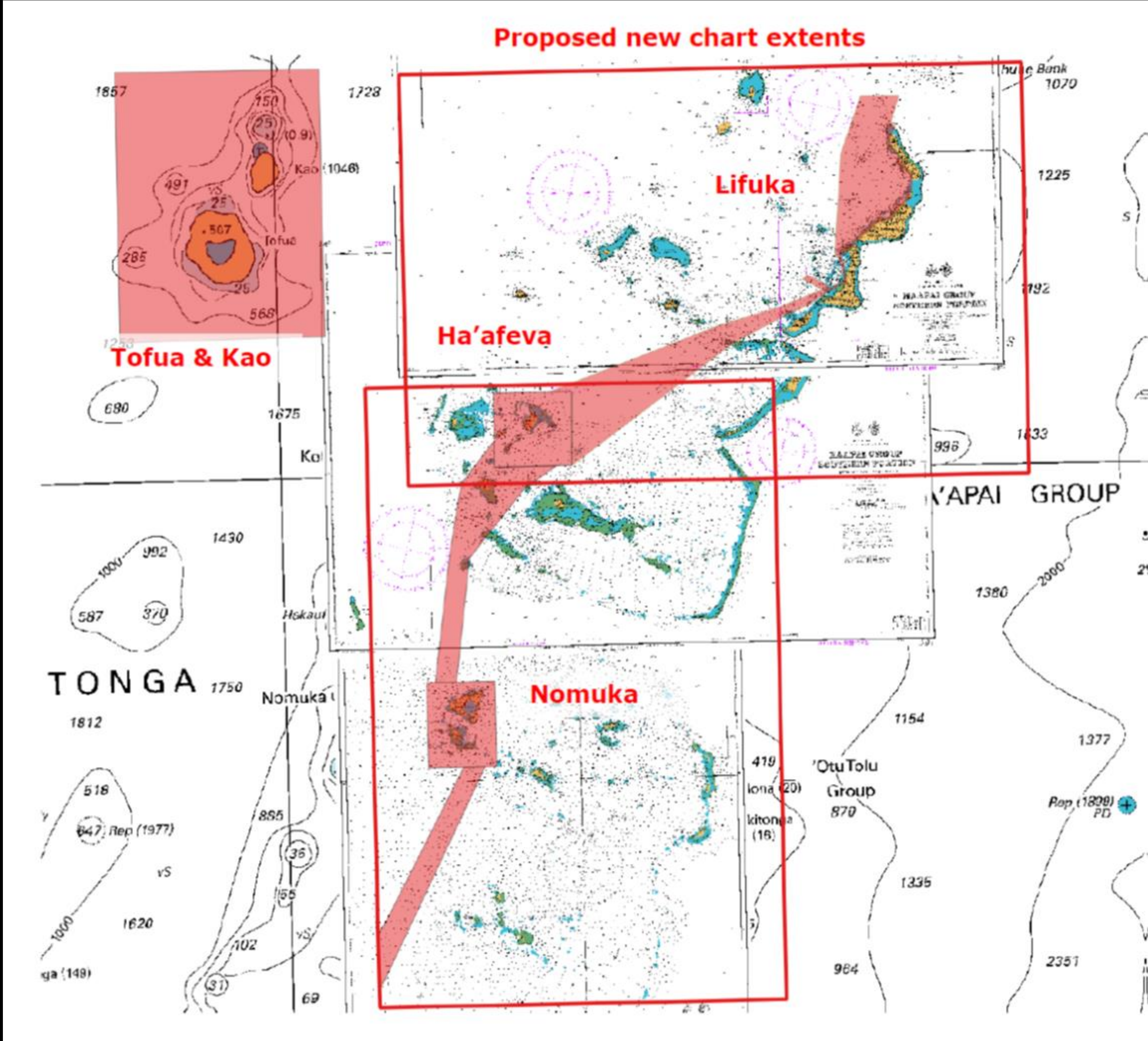


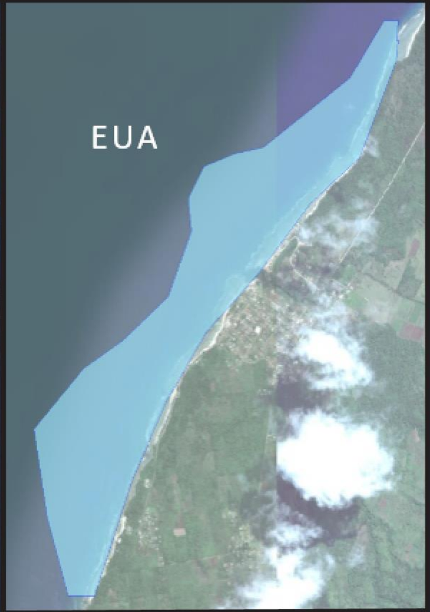
Pacific Regional Navigation Initiative (PRNI)

Sensor Type #2

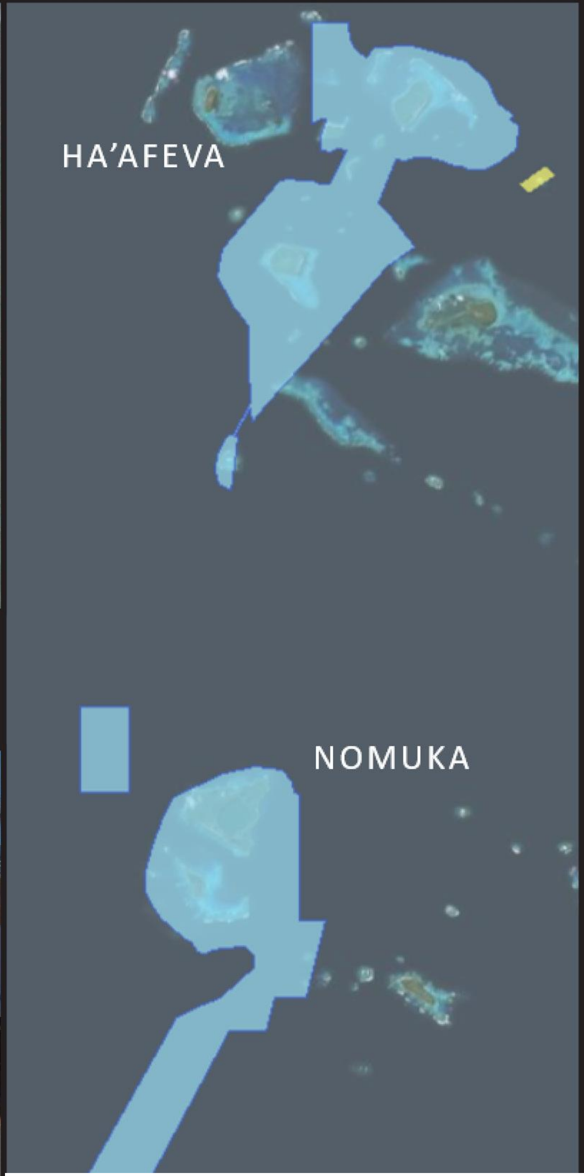
Airborne Lidar

Bathymetry





Airborne LiDAR



GEOMATICS
DATA SOLUTIONS

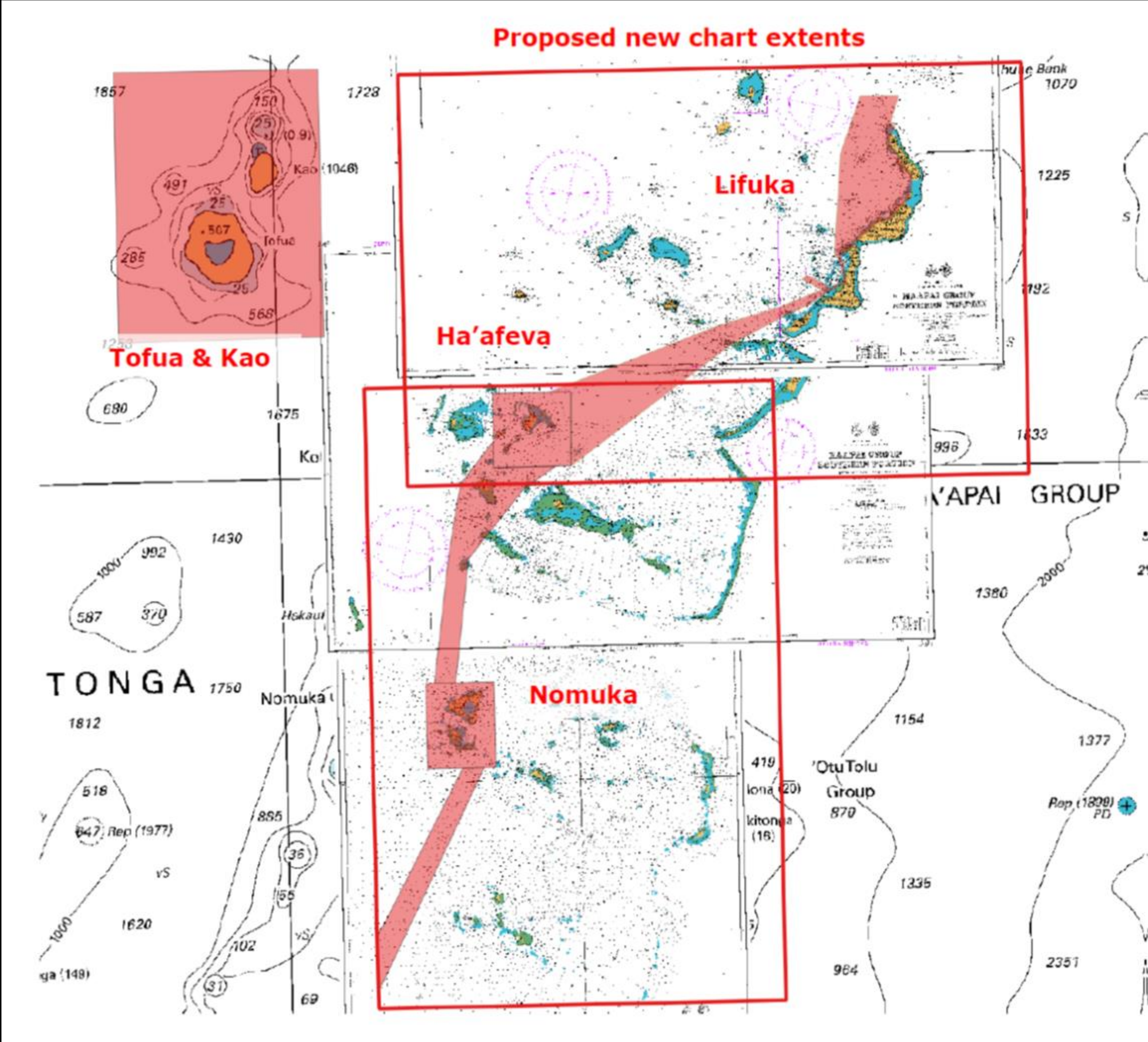
Pacific Regional Navigation Initiative (PRNI)

Sensor Type #3

Vessel mounted

Multi-beam

Echosounder

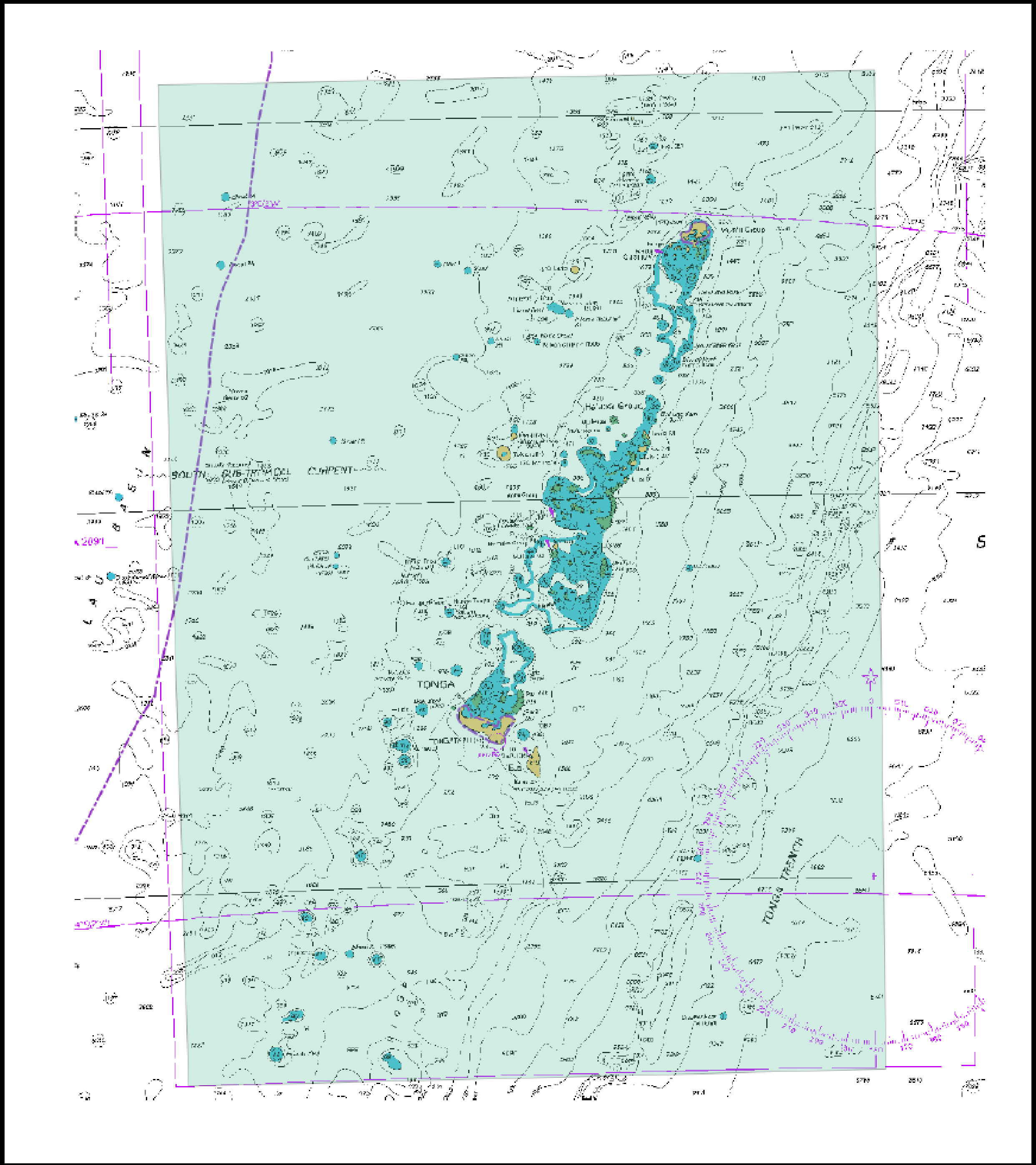


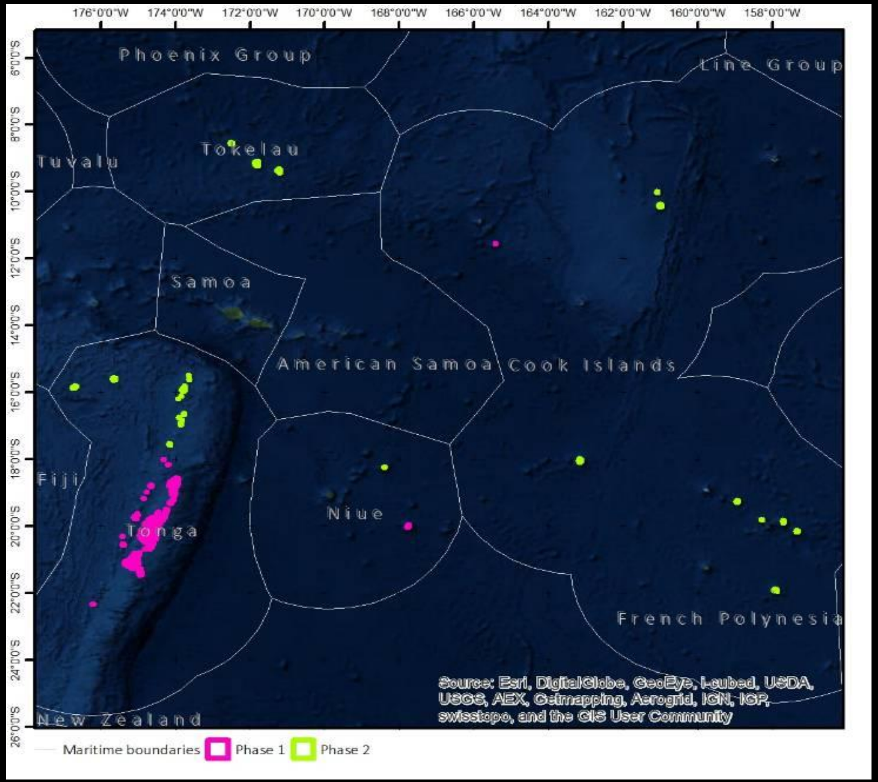
The How & When

Several Key Phases:

- SDB processing and reporting (Nov 2017 – May 2018)
- ALB data collection (6 – 23 July 2018)
- Tides and Geodetics (17 Aug – 10 Sep 2018)
- MBES data acquisition (8 Nov – 24 Dec 2018)
- MBES and ALB data processing and reporting (Aug 2018– April 2019)

SDB coverage

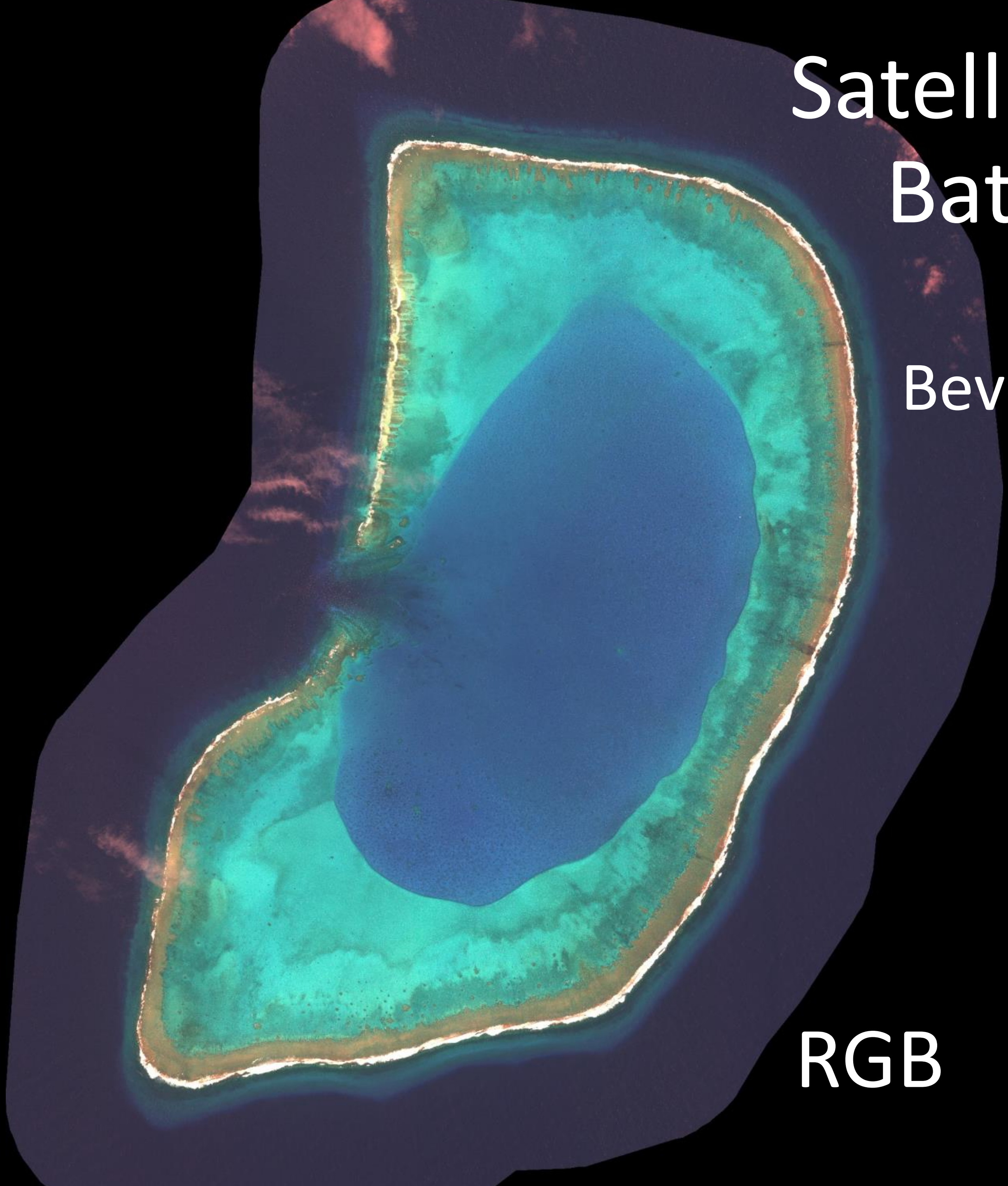




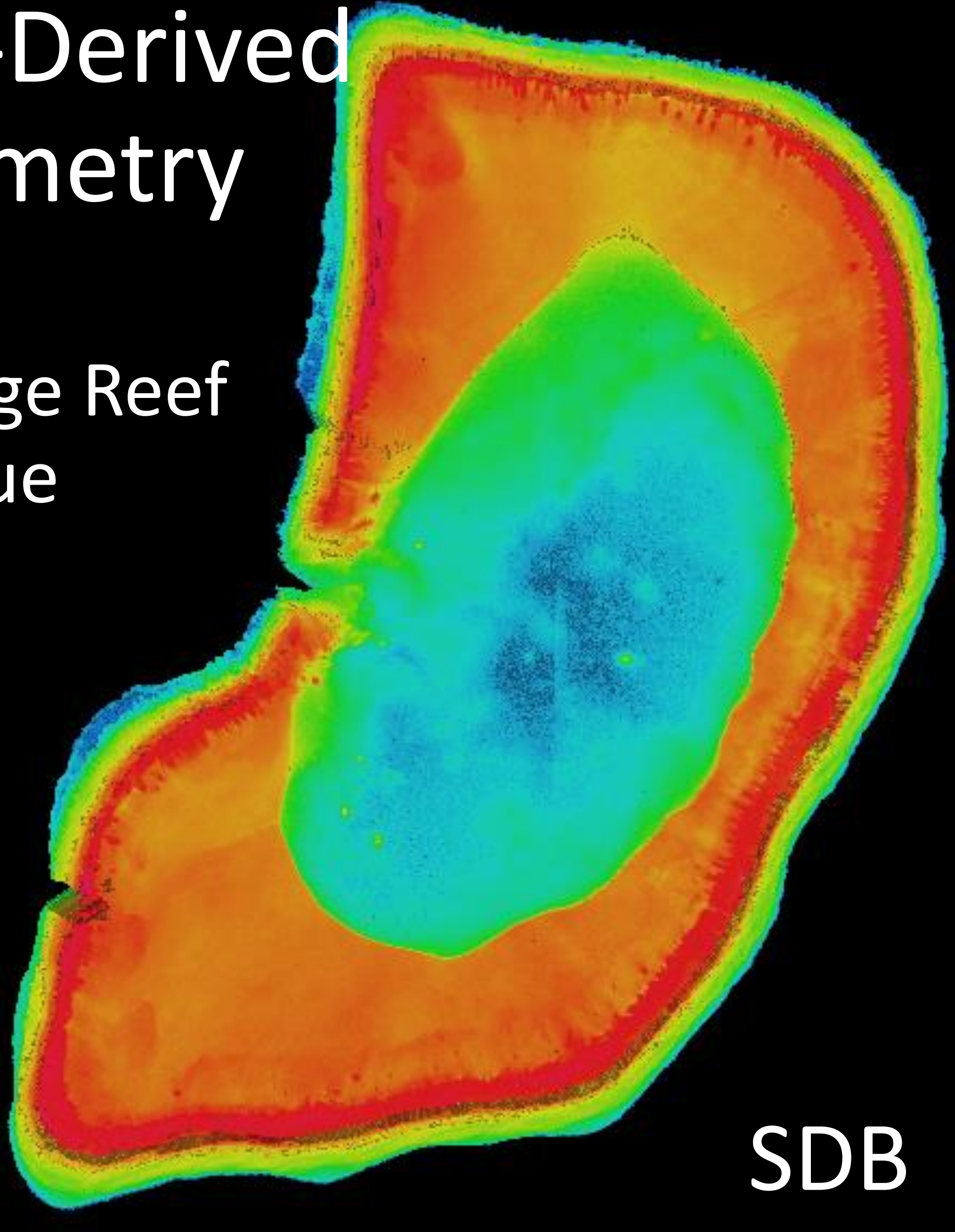
EOMAP

Satellite-Derived Bathymetry

Beveridge Reef
Niue

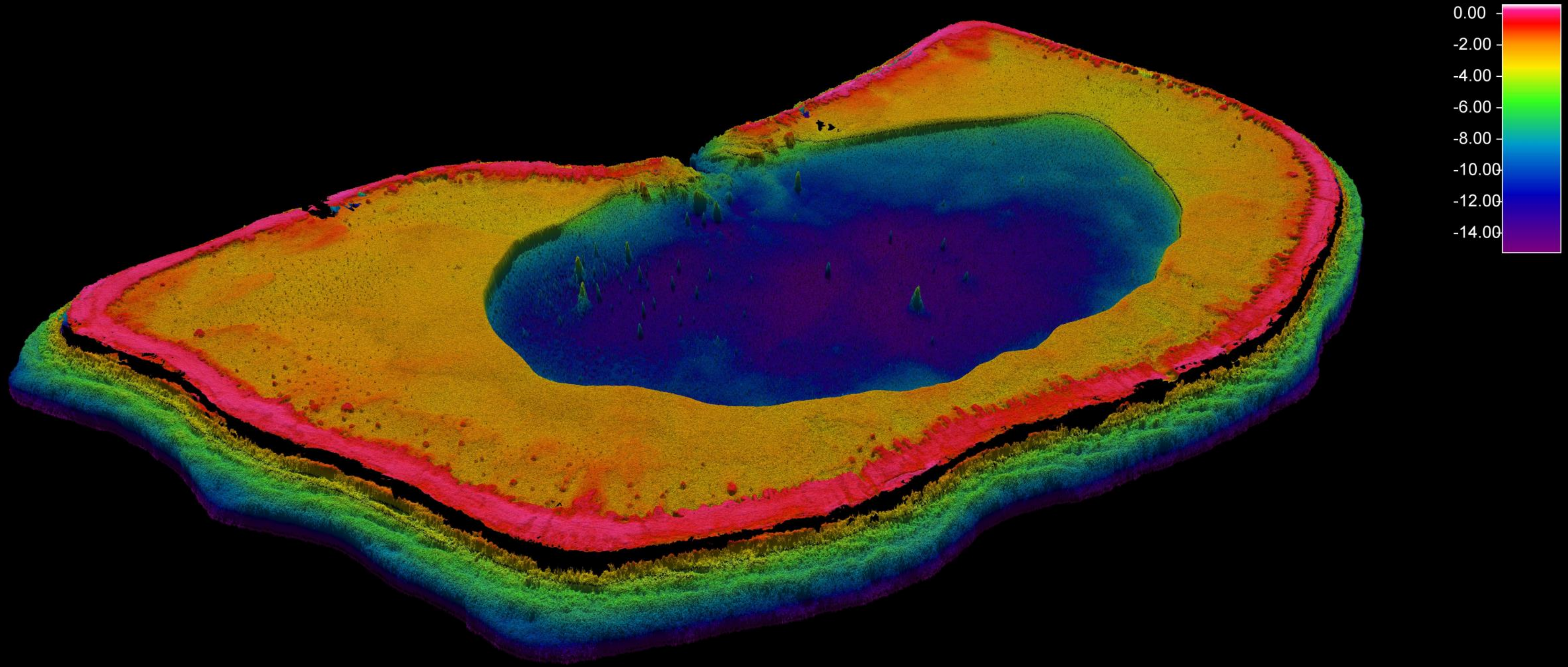


RGB



SDB

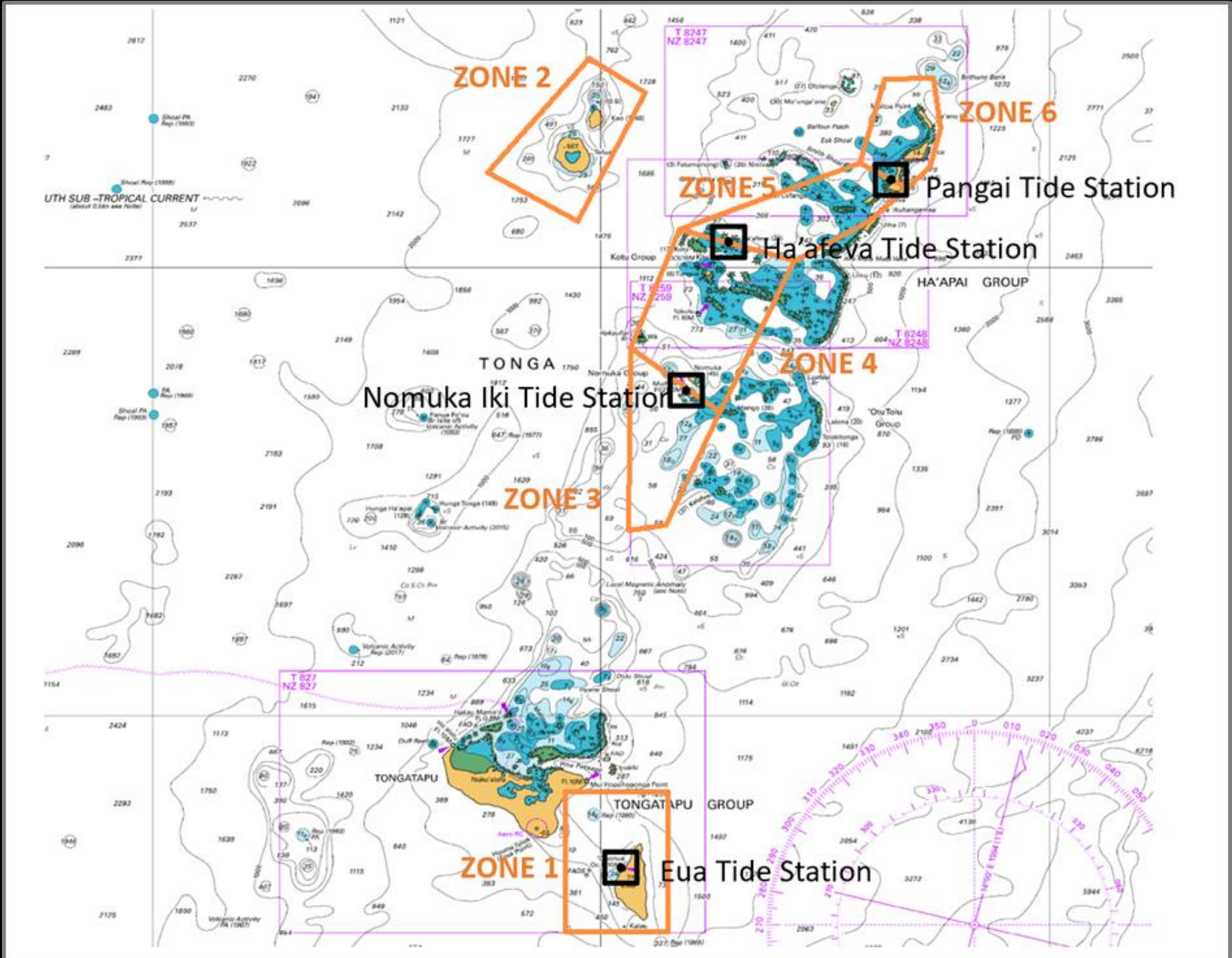
SDB
Beveridge Reef
Niue



Tides and Geodetics

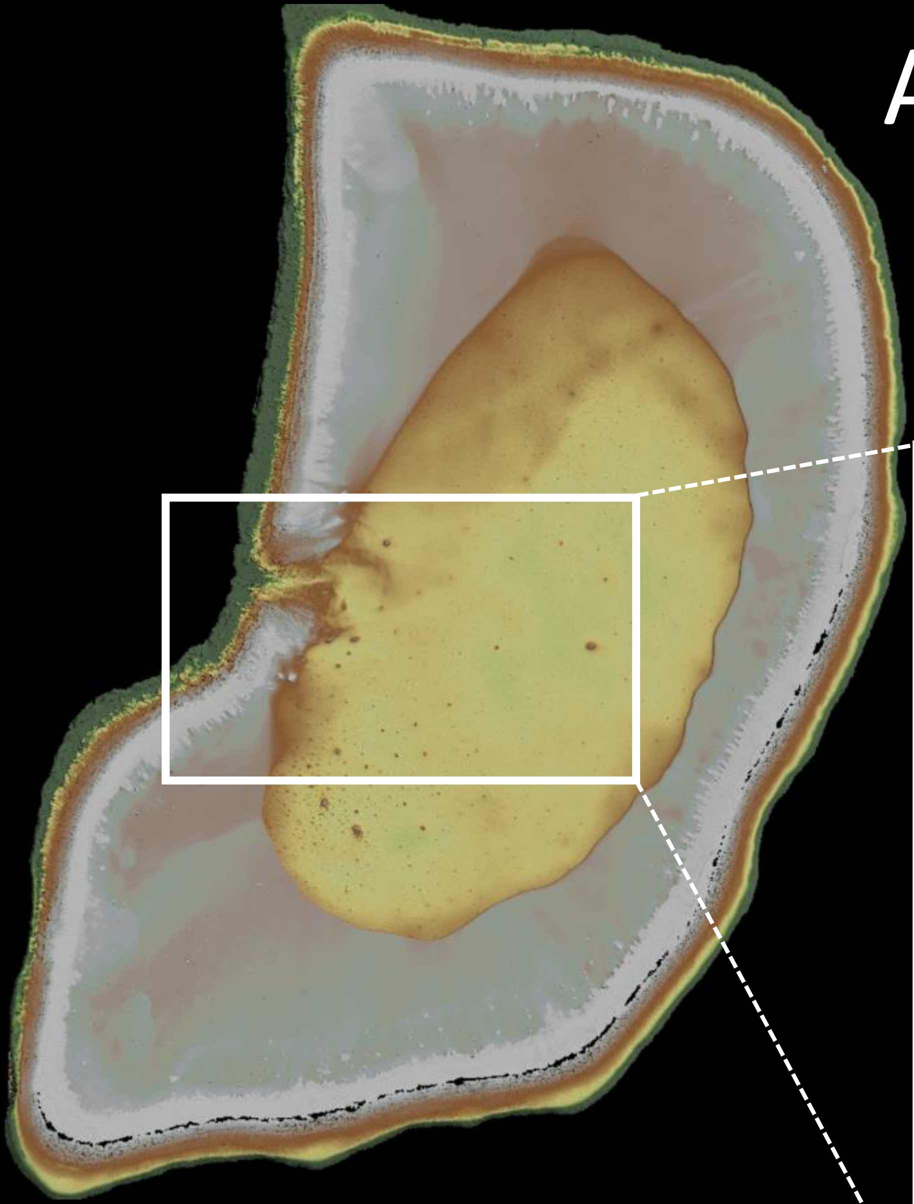
iXblue

Tidal Zone Areas

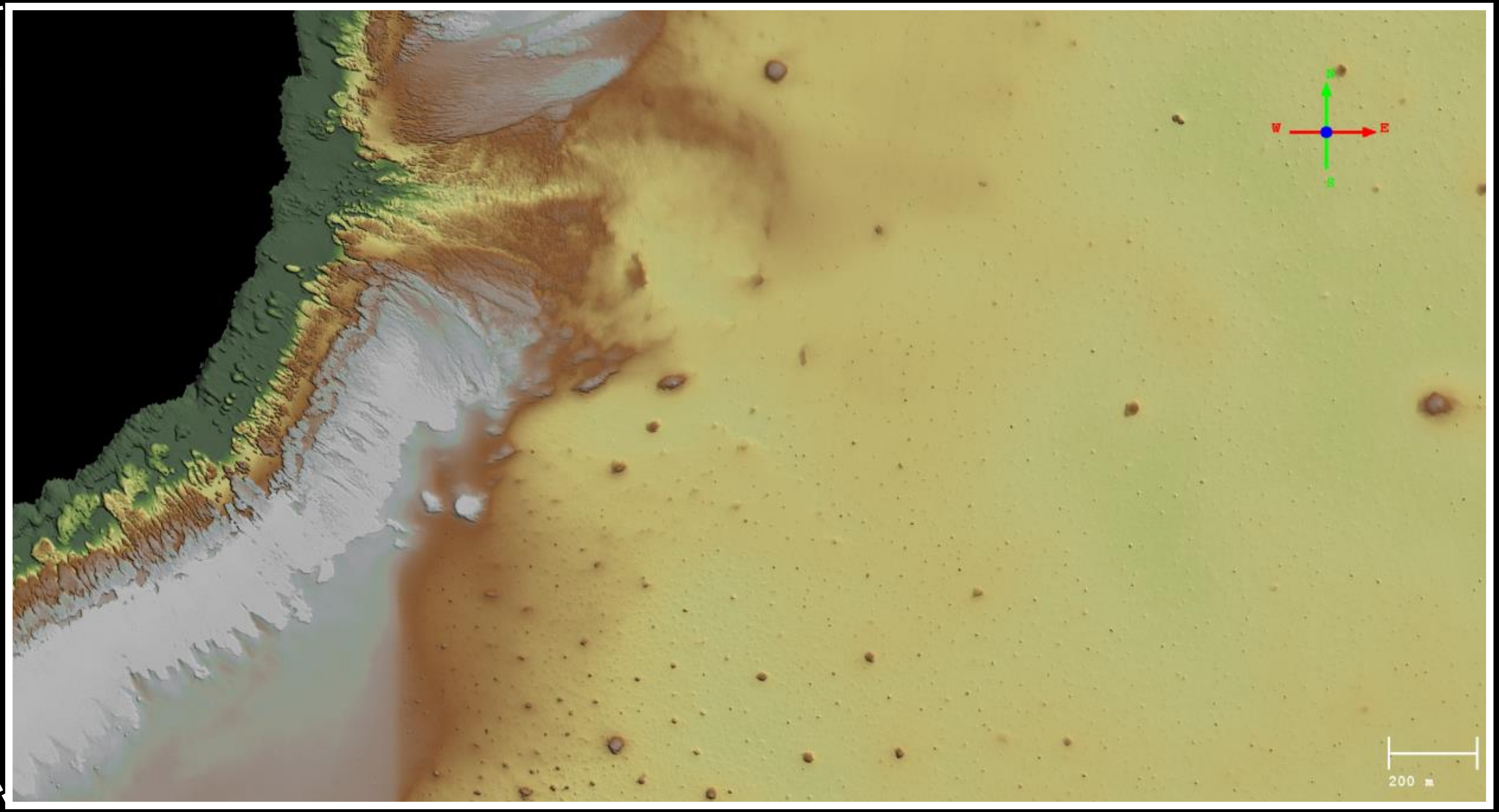


iXblue

Airborne LiDAR Bathymetry



Beveridge Reef, Niue

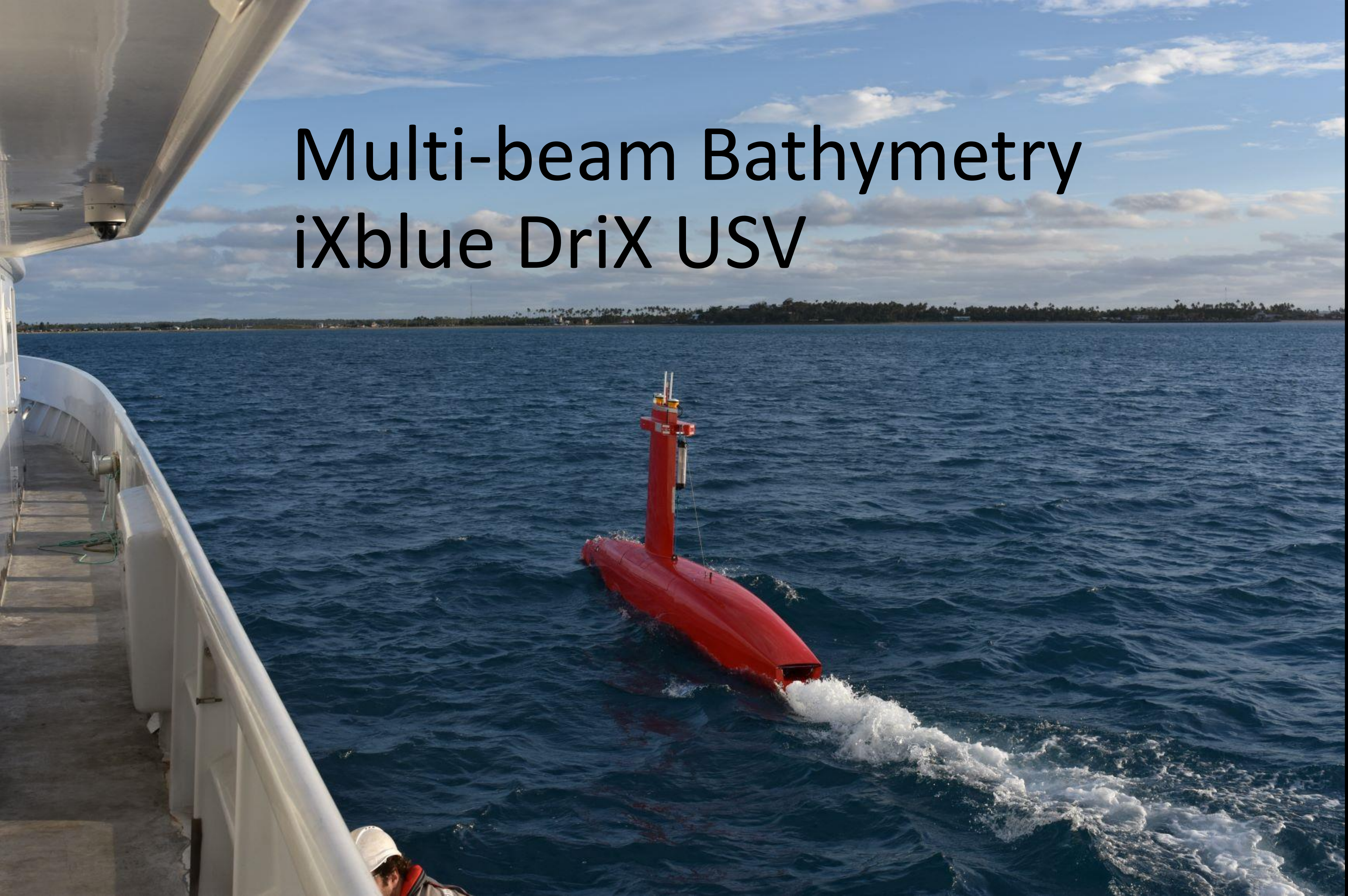


Multi-beam Bathymetry

MV Silent Wings

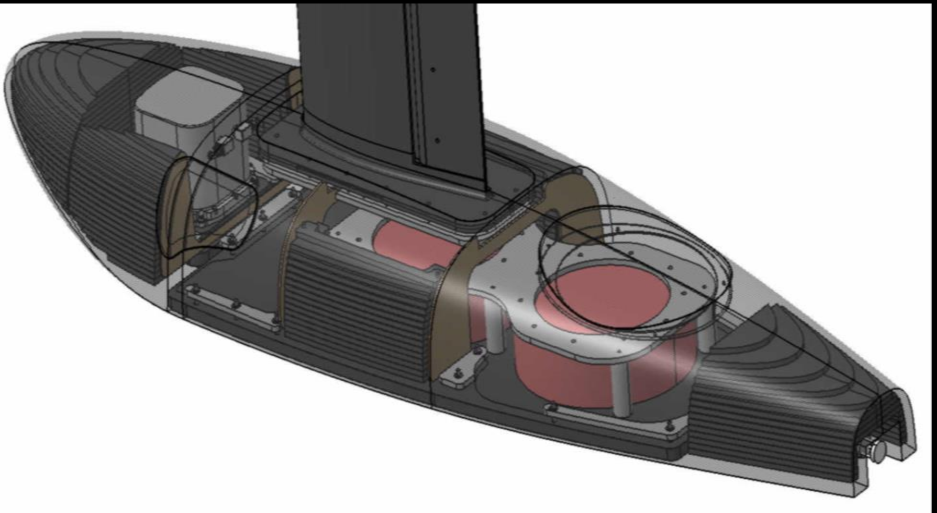
iXblue

Multi-beam Bathymetry
iXblue DriX USV



DriX Survey System

- INS iXblue PHINS C7
- MBES Kongsberg Em2040C dual swath/FM Chirp
- GNSS Trimble SPS855 & Septentrio AsterX-U
- SVS Valeport miniSVS
- CARIS Onboard

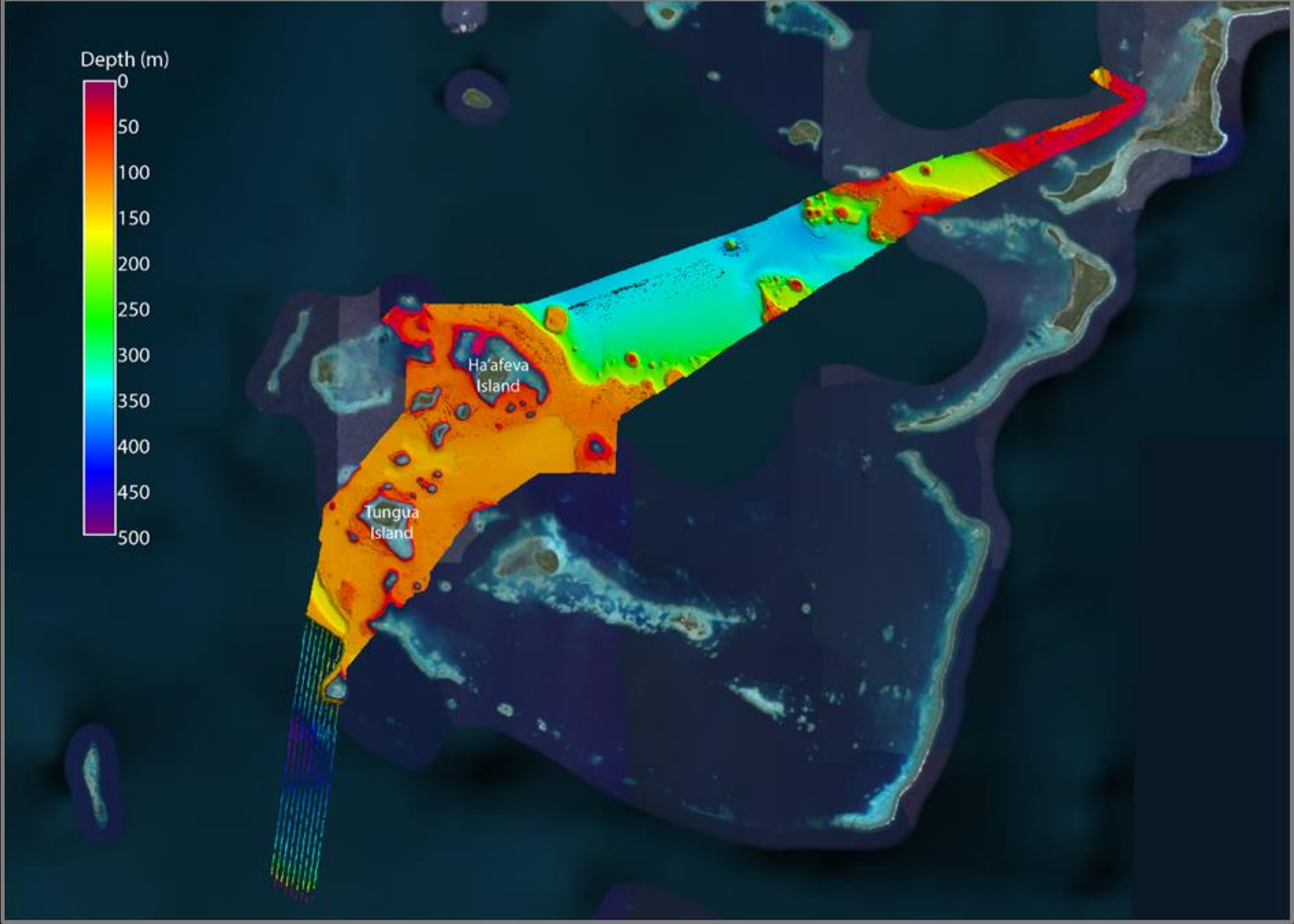


SILENT WINGS Survey System

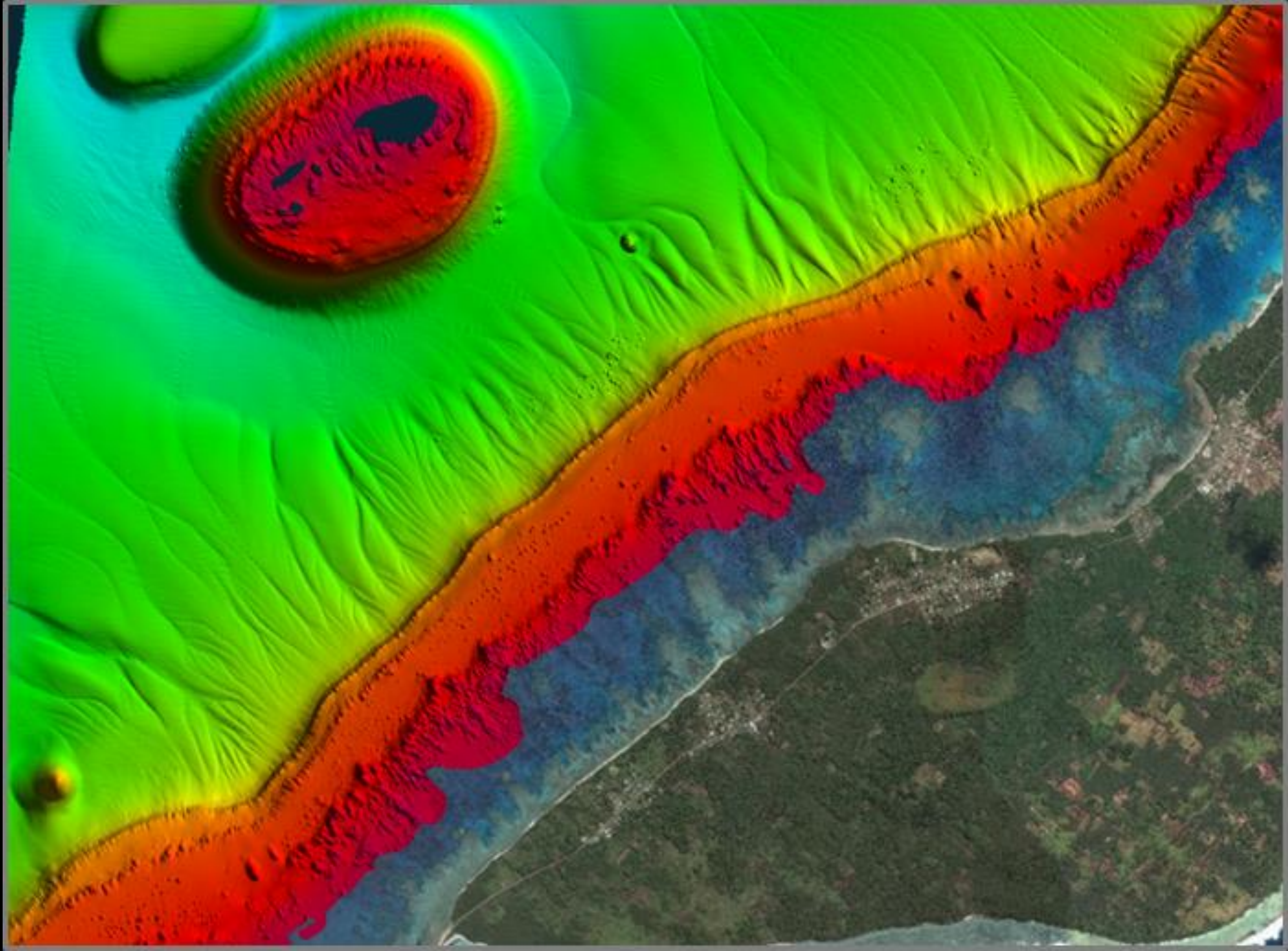
- INS iXblue ROVINS (x2)
- MBES Kongsberg Em2040C dual swath/FM Chirp
- SBES Odom 200/33 kHz
- GNSS Fugro MarineStar 9205 (G2+)
- SVS Valeport miniSVS, RapidSVT, SWIFT
- Teledyne OceanScience SVP winch
- QPS QINSy
- CARIS HIPS

Vessel Departure – Oct 2018

Multibeam Data

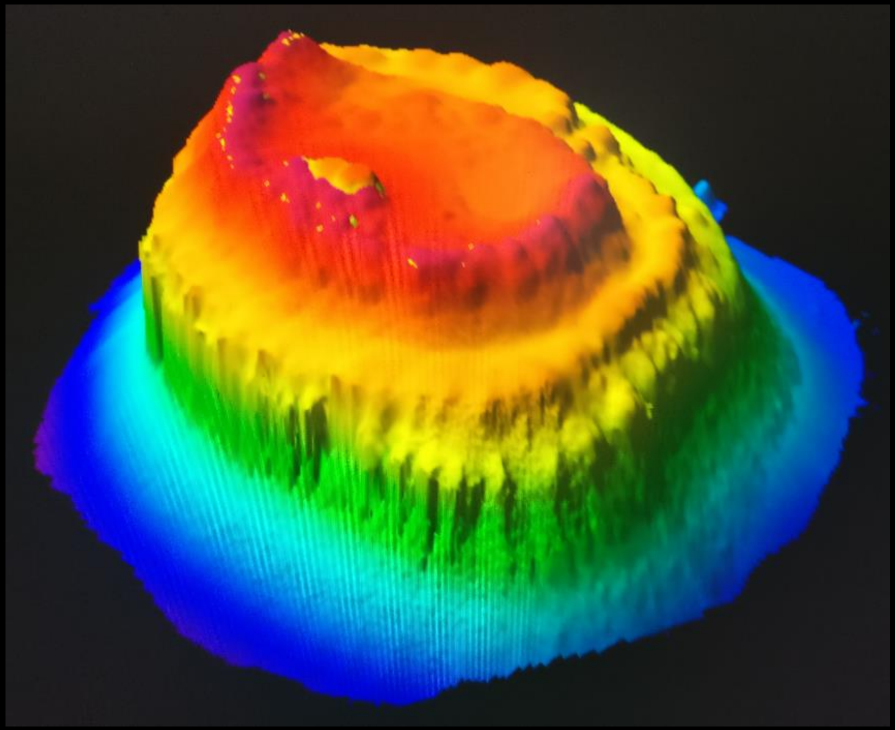


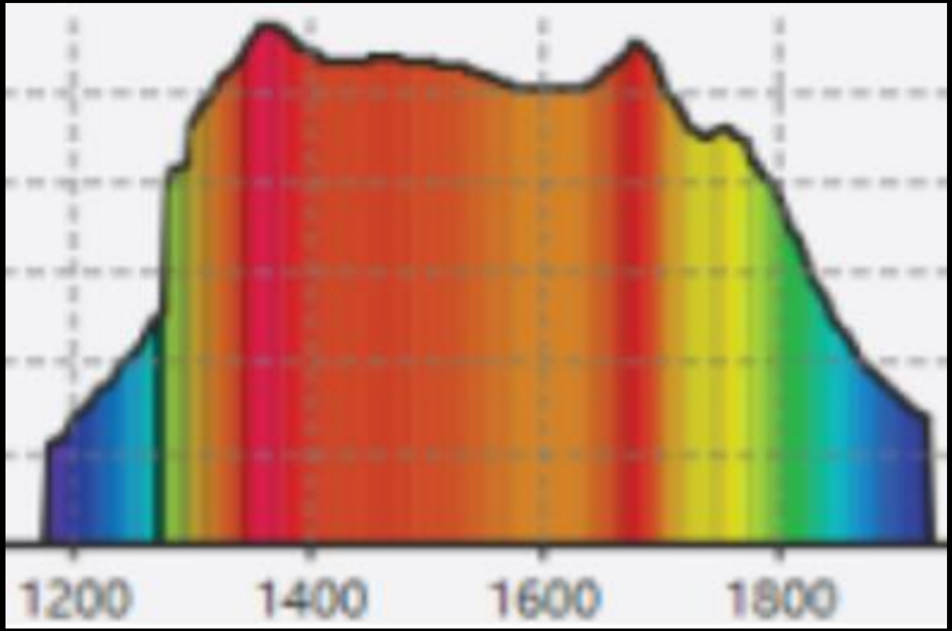
Multibeam Data

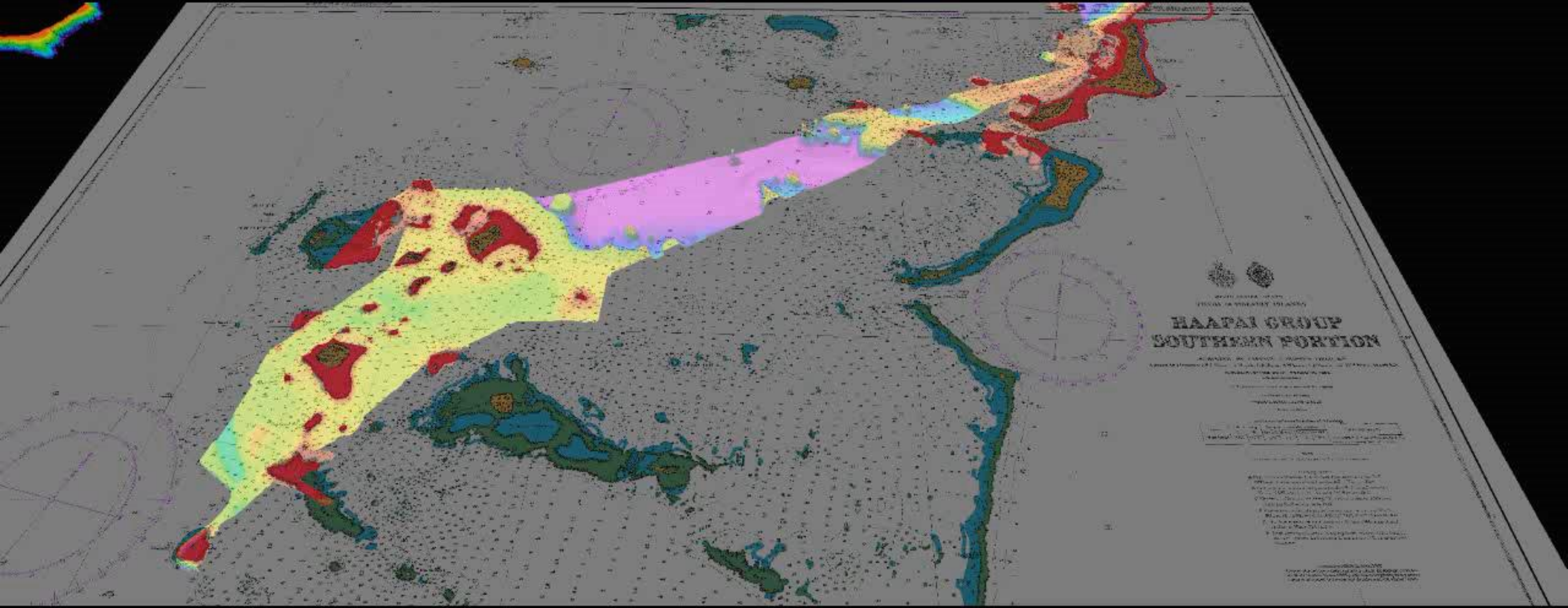


Reminder of the utility of hydrographic survey for safety of navigation.

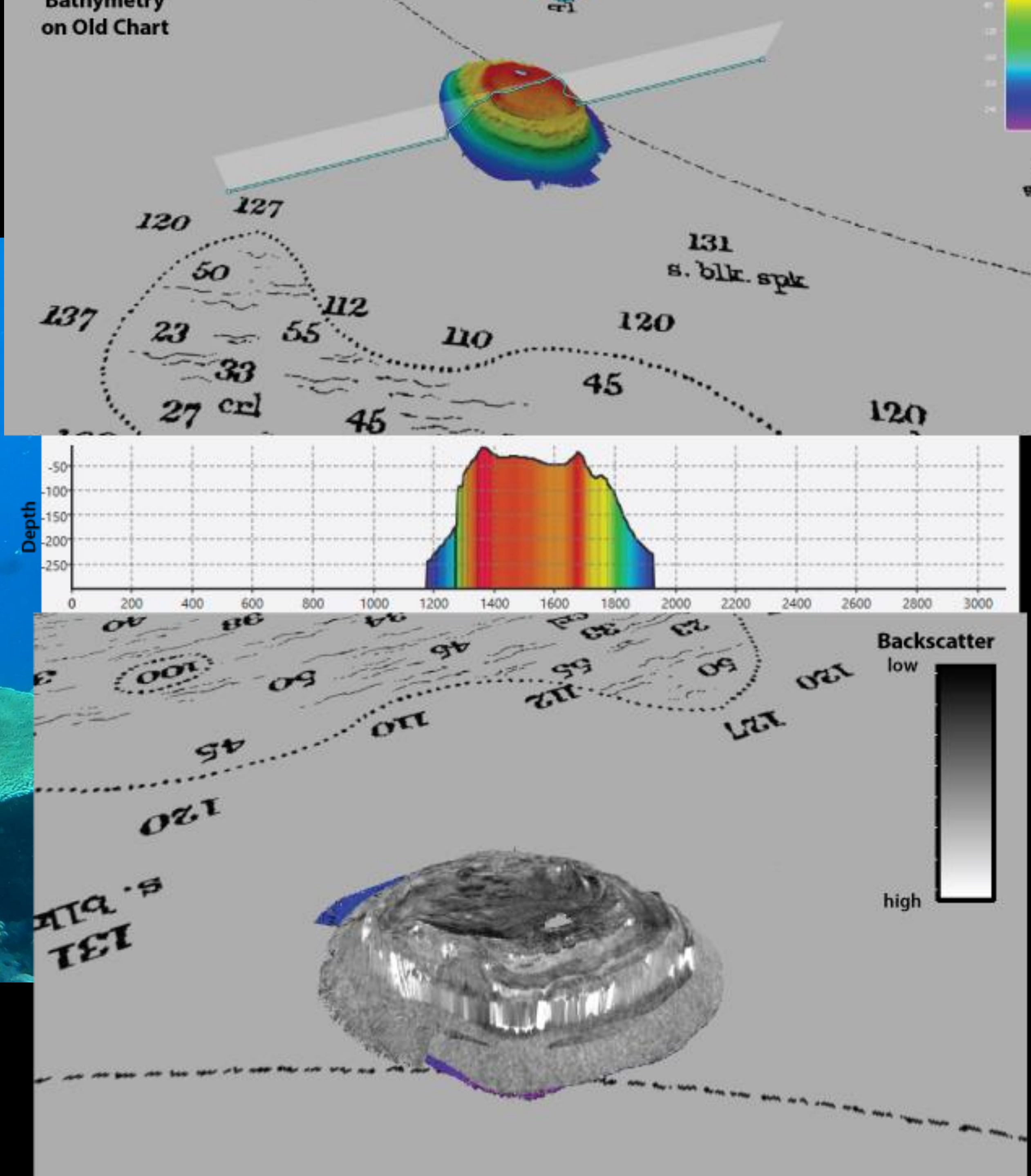
From 300m to 6m deep!






HAAPAI GROUP
SOUTHERN PORTION

Coral Reefs


on Old Chart
127
120
131
s. blk. spk
50
112
137
23
55
110
120
33
45
27 crl
45
120
Depth
-50
-100
-150
-200
-250
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Backscatter
low
high

Update – What's next?

- Analyse SDB, ALB and MBES datasets to better understand performance of each

Opportunity for EOMAP to use the finalized, high resolution dataset of the ALB and MBES to further refine the SDB dataset.

Project highlights:

Series of firsts:

1. First time in the world a multi-sensor survey of this scale had been attempted
2. First time SDB has been used to update nautical charts on this scale
3. First time the Chiroptera 4x ALB had been used on large area survey
4. First time iXblue DriX USV used on contract survey

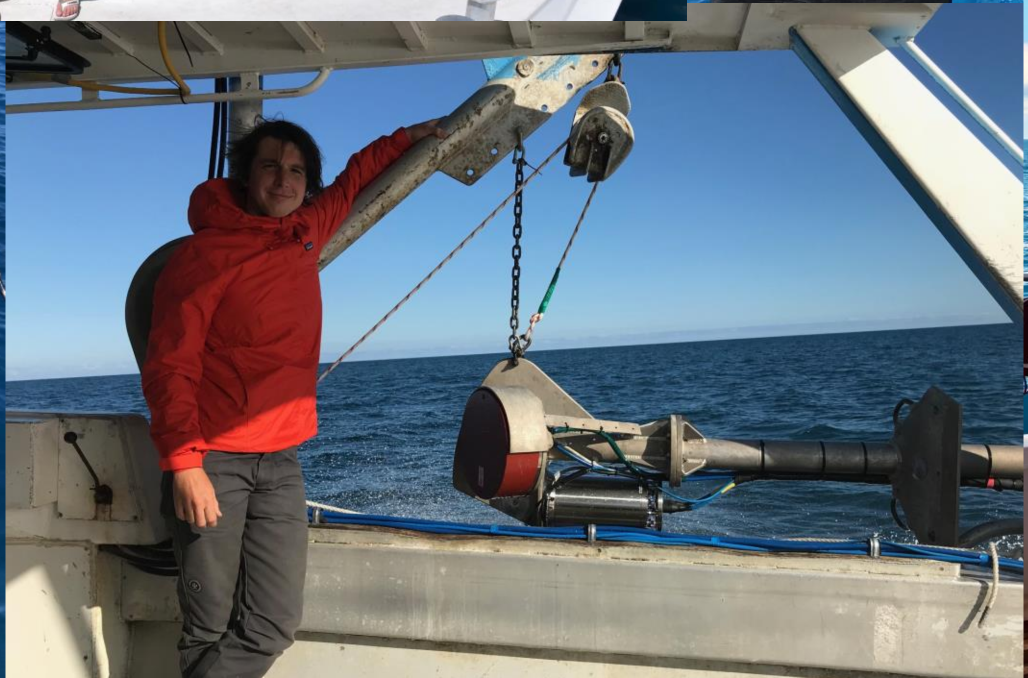
Satellite Derived Bathymetry

- Cost effective (quicker, cheaper and safer)
- Ideally suited to the SW Pacific where water clarity is high
- Ideal tool to integrate with higher resolution/higher cost surveys utilising aircraft or vessel mounted sensors.

EOMAP


iXblue
iXblue


We LOVE
what we do!
iXblue



Acknowledgements:

Mr Adam Greenland (LINZ National Hydrographer)

Ms Carol Lockhart (GDS)

Dr Magnus Wettel (EOMAP)

Thank You

Land Information New Zealand
Toitū te whenua

iXblue

GEOMATICS
DATA SOLUTIONS

EOMAP