Aotearoa New Zealand's Place in Space

Dr Sarah Kessans

University of Canterbury

Dr Dave Kelbe

Xerra Earth Observation Institute

Speaker's Science Forum

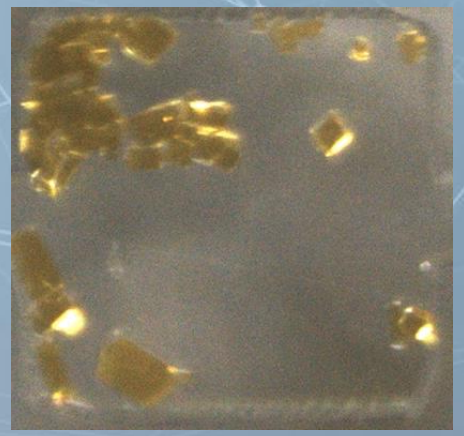
Aotearoa New Zealand

Diversifying the space sector

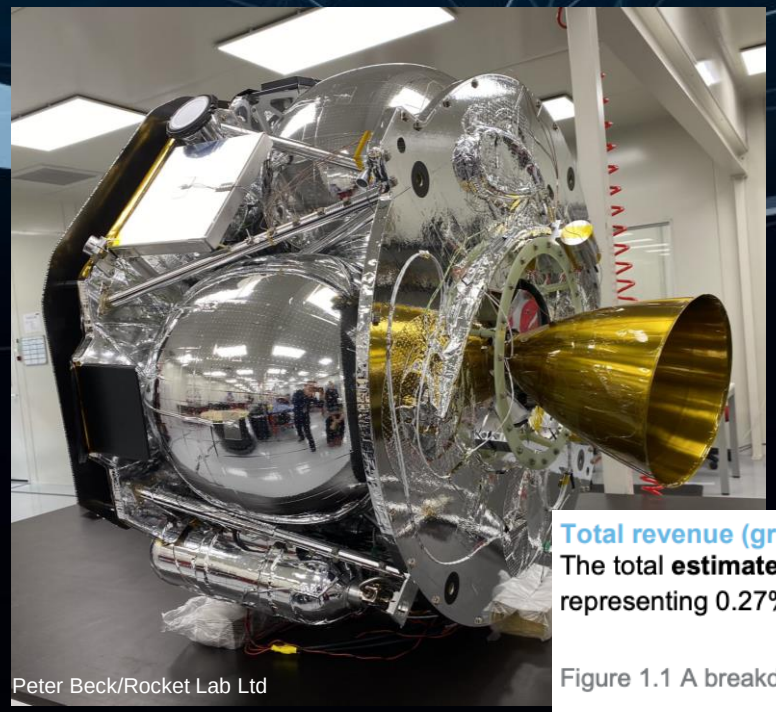
Dr Sarah Kessans

School of Product Design, University of Canterbury

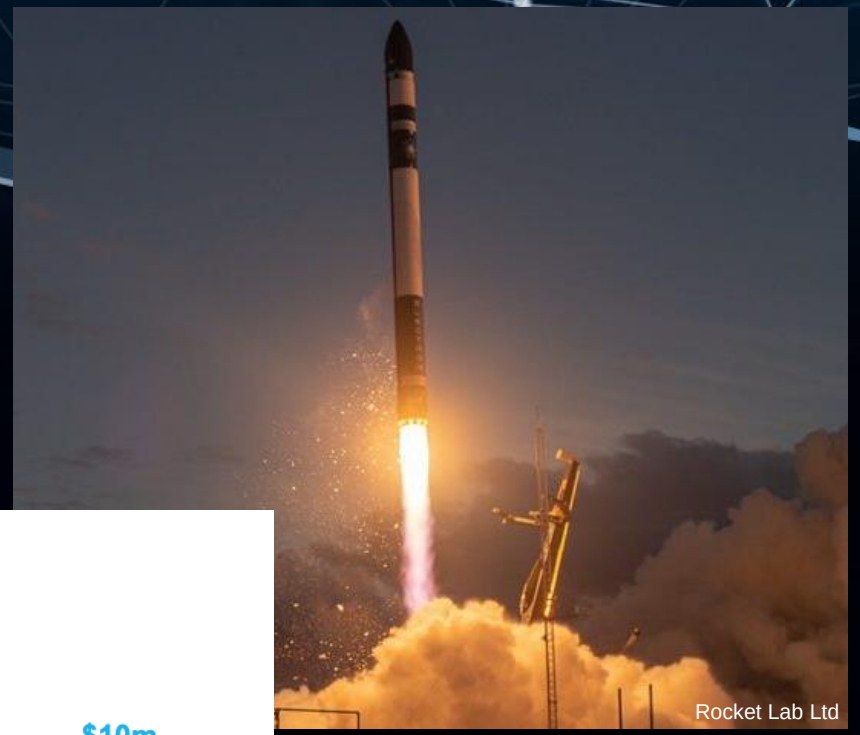
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND



Speaker's Science Forum
Aotearoa New Zealand


Peter Beck/Rocket Lab Ltd

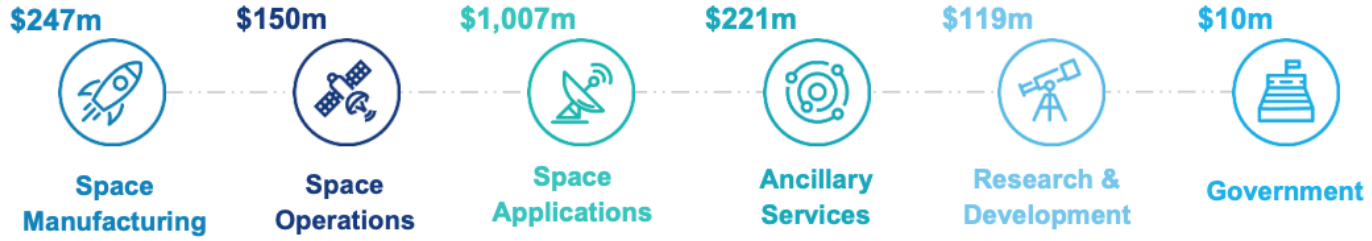

Dawn Aerospace


Rocket Lab Ltd

Total revenue (gross output) of New Zealand's space economy

The total **estimated revenue of the space economy is $1.75 billion in 2018-19**, representing 0.27% of global space economy revenues.

Figure 1.1 A breakdown of the estimated space revenue across sub-sectors



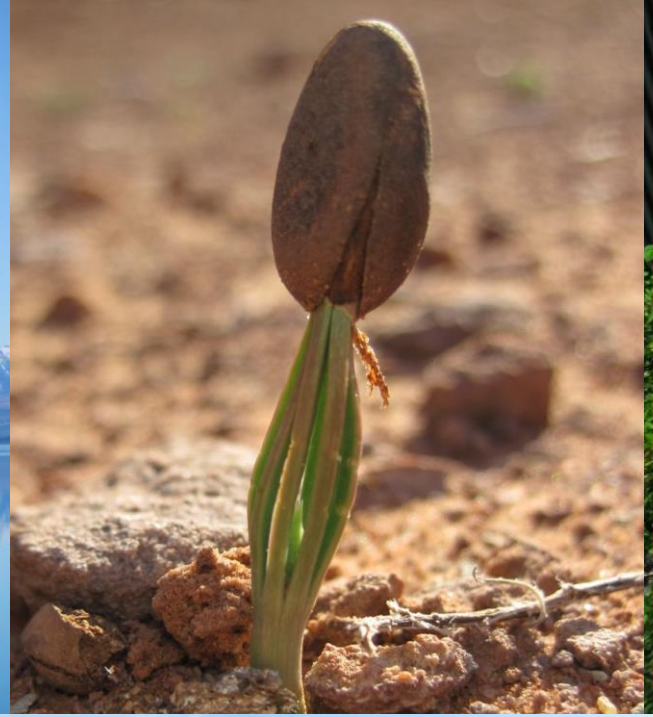
Source: Deloitte Access Economics


Kea Aerospace


Awarua SGS


Environmental Defense Fund

The Martian (2015)




Culture Bag
P/N CASIS-ALGAE-1
00249715K
2
Culture Bag
P/N CASIS-ALGAE-1
00249719K
2
Culture Bag
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Culture Bag
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NASA Images

Off the Earth, For the Earth

- Resource-limited environment
  - Sustainability is critical
  - Microgravity and radiation
- Unique environment for research
  - Materials, combustion, robotics
  - Microbiology, plant biology, human physiology


NASA Images

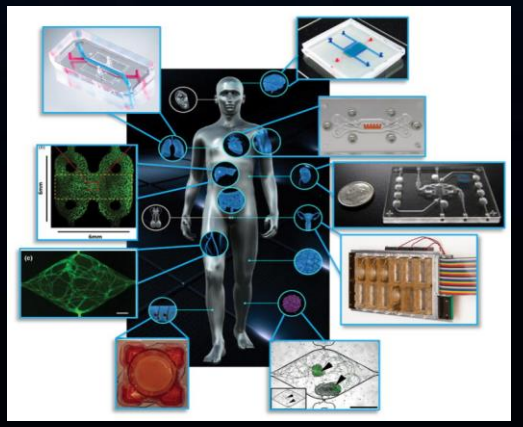

NASA Images


NASA Images


NASA Images

Research on the International Space Station

- **1000s of biomedical experiments over 20 years**
  - Clinical applications
  - Advanced life support system development
  - Pharmaceutical research & development
    - Drug development
    - Compound testing in 3D cell cultures
    - Manufacturing
      - Antibody purification not available on Earth



- **Who uses the facilities?**
  - Research organisations
  - Universities/CRIs
  - Government laboratories
  - Private laboratories

Research on the International Space Station

- Limited space
- Limited and expensive astronaut time
- Infrequent launches
- Long lead-in times

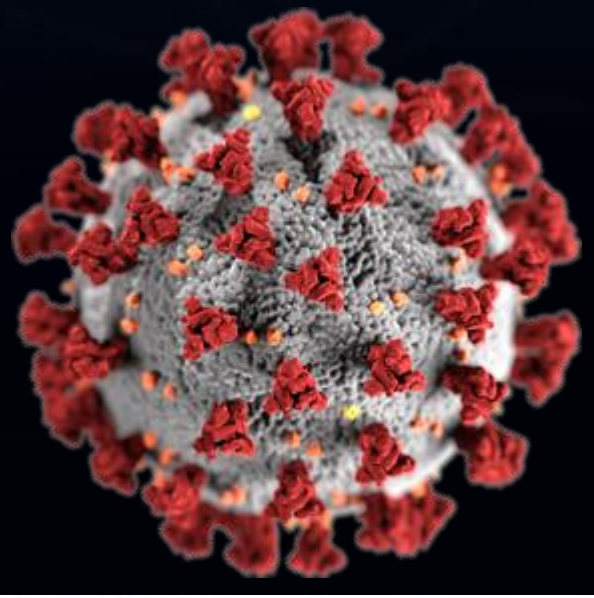
Tiny satellites = big opportunities

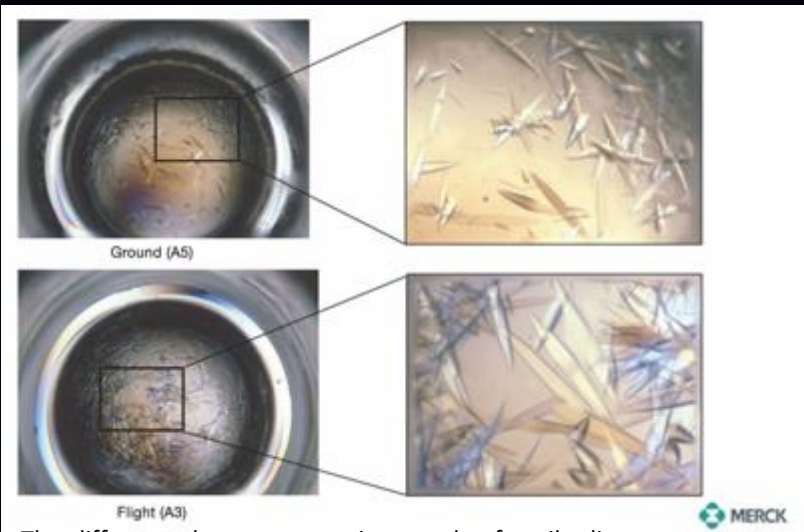
- **CubeSats**
  - 1U = 10 x 10 x 10 cm
  - Autonomous miniaturised laboratories
- Aotearoa New Zealand uniquely placed for development/manufacture/launch

UofAuckland's APSS-1 1U CubeSat

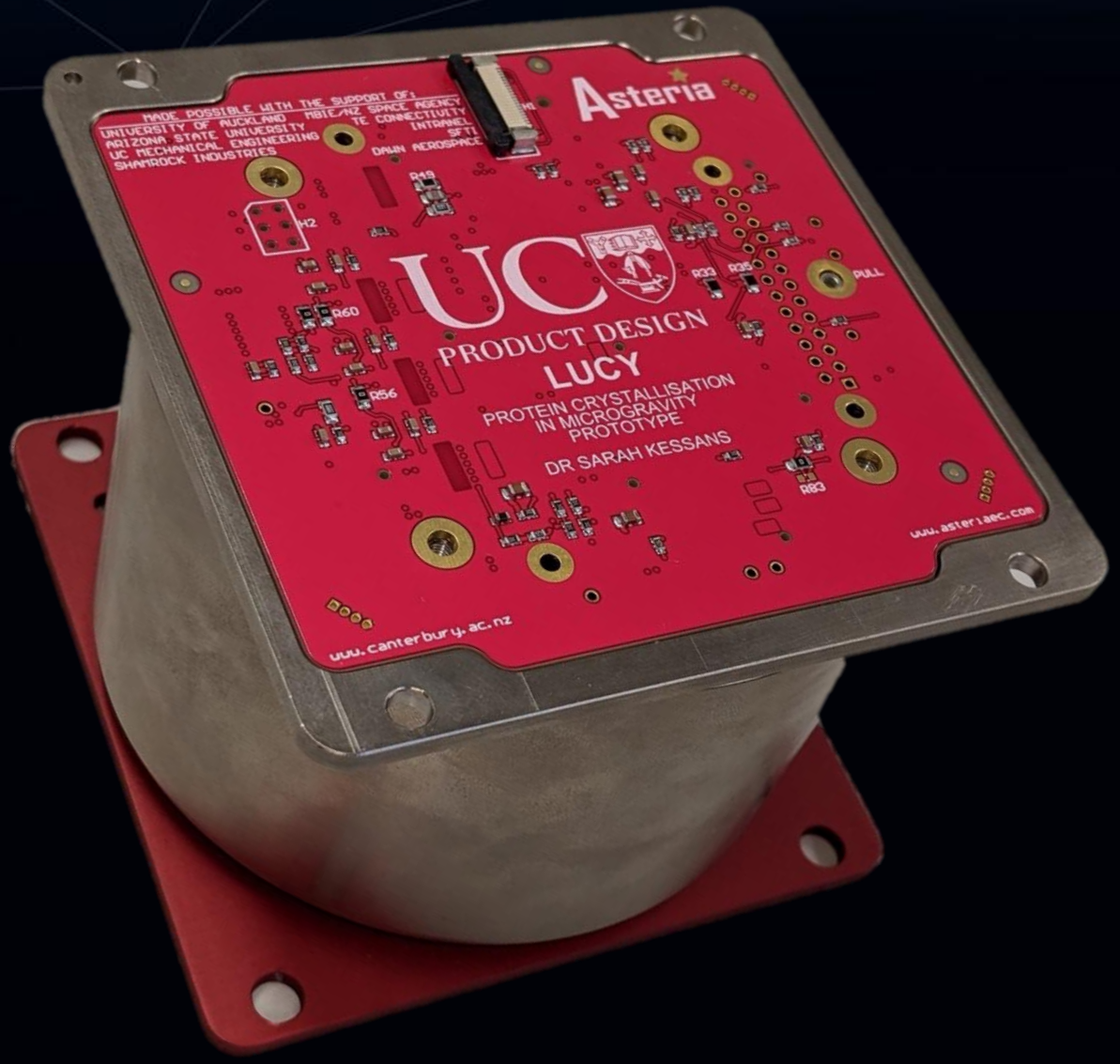
Studying proteins in microgravity

- Protein structure is critical for understanding life
  - Developing therapies and vaccines
- Protein crystallography = integral for structural determination
- Protein crystals can be difficult to grow in gravity
  - Microgravity can produce much bigger, higher-quality crystals than those produced on Earth
    - Faster, better therapies/vaccines





The difference between protein crystals of antibodies grown on the ground (top) versus in microgravity (bottom). (Merck 2015)



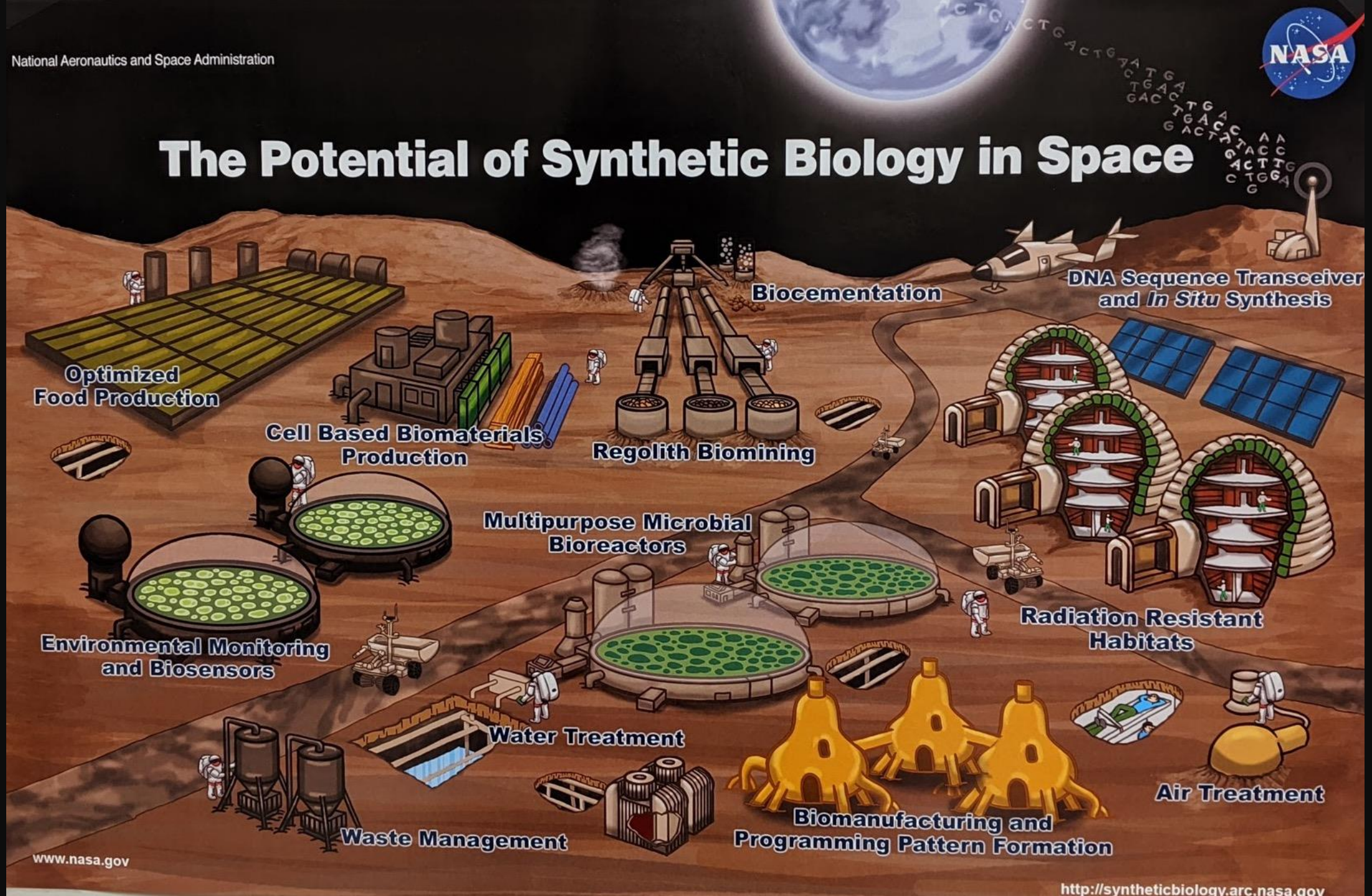
Meet **LUCY**

Lysozyme
μ-gravity
Crystallisation
pa**y**load

Launch January 2022

National Aeronautics and Space Administration

The Potential of Synthetic Biology in Space



www.nasa.gov

http://syntheticbiology.arc.nasa.gov

UC PRODUCT DESIGN

UC Mechanical Engineering

UC AEROSPACE

Asteria Engineering Consultancy

Intranel

DAWN AEROSPACE

TE connectivity

ASU Arizona State University

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SHAMROCK INDUSTRIES

Aerospace Christchurch

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

National SCIENCE Challenges
SCIENCE FOR TECHNOLOGICAL INNOVATION
Kia kotahi mai – Te Ao Pūtaiao me Te Ao Hangarau

NEW ZEALAND SPACE AGENCY

Doug Hurley/NASA Images

What goes up must look down

Dr Dave Kelbe

Xerra Earth Observation Institute

Jo Coughlan

Silvereye

Speaker's Science Forum

Aotearoa New Zealand

What goes up must look down

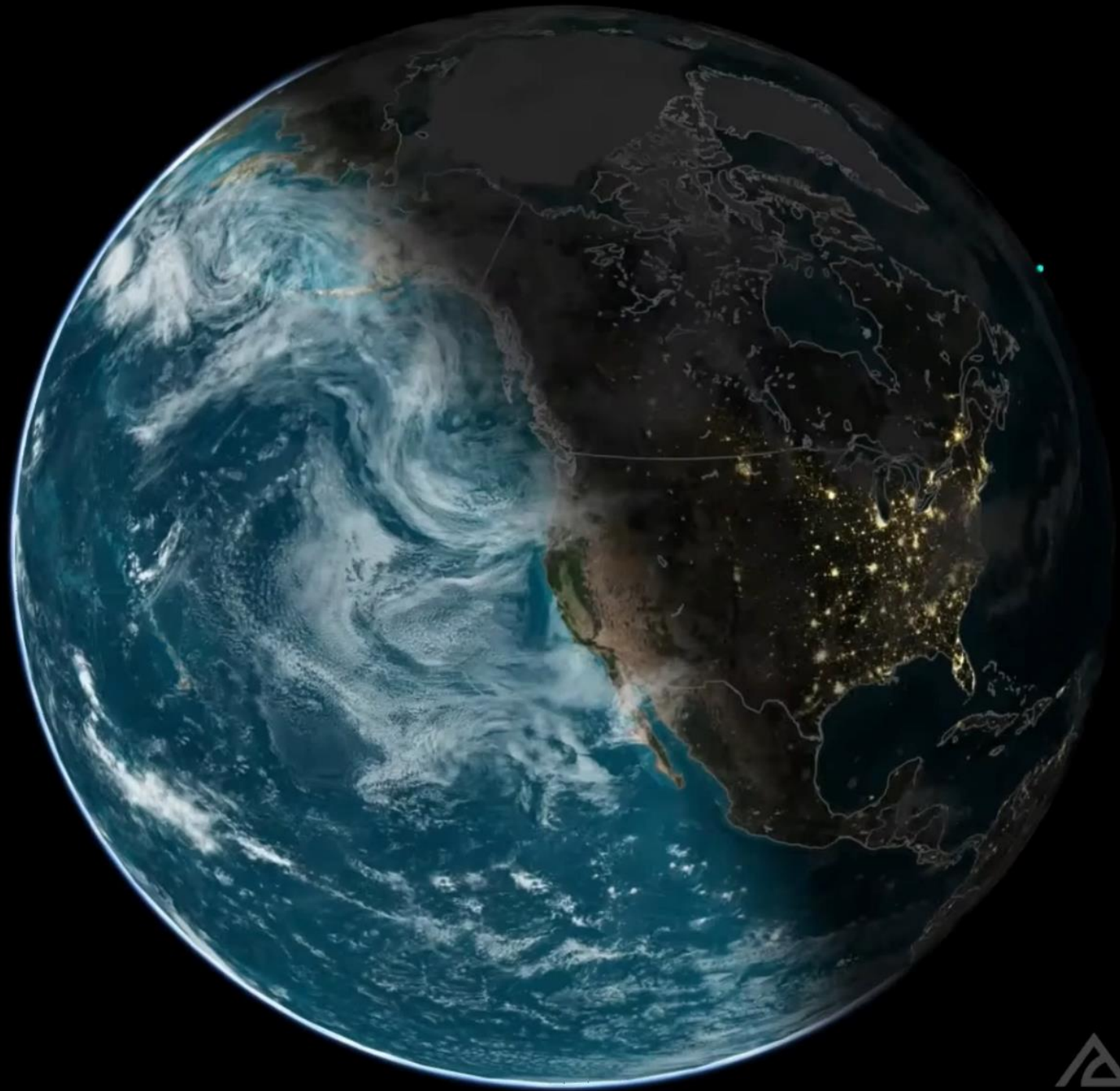
Turning data from satellite sensors into operational intelligence for Aotearoa's maritime domain awareness

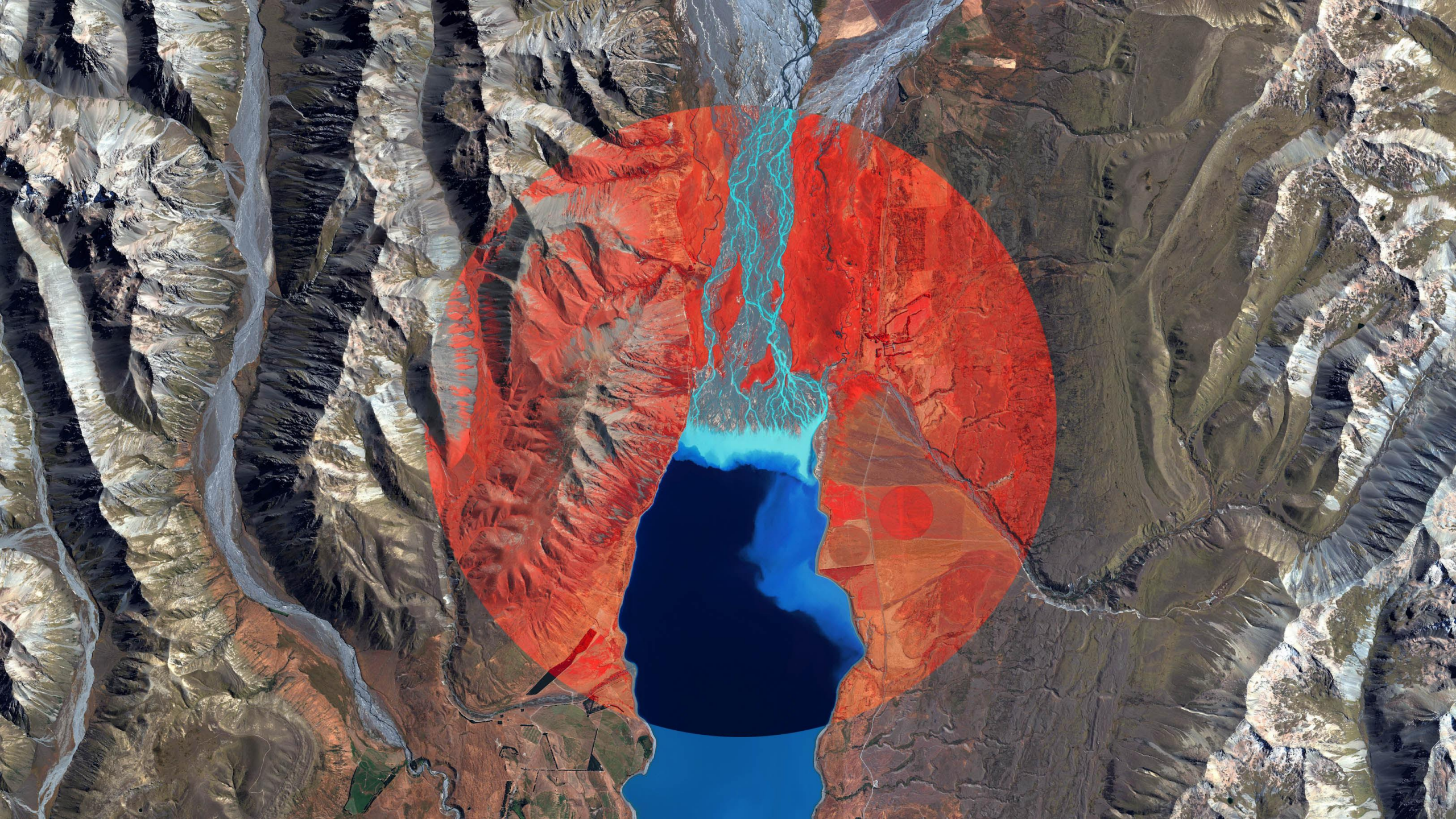
Starboard Maritime Intelligence

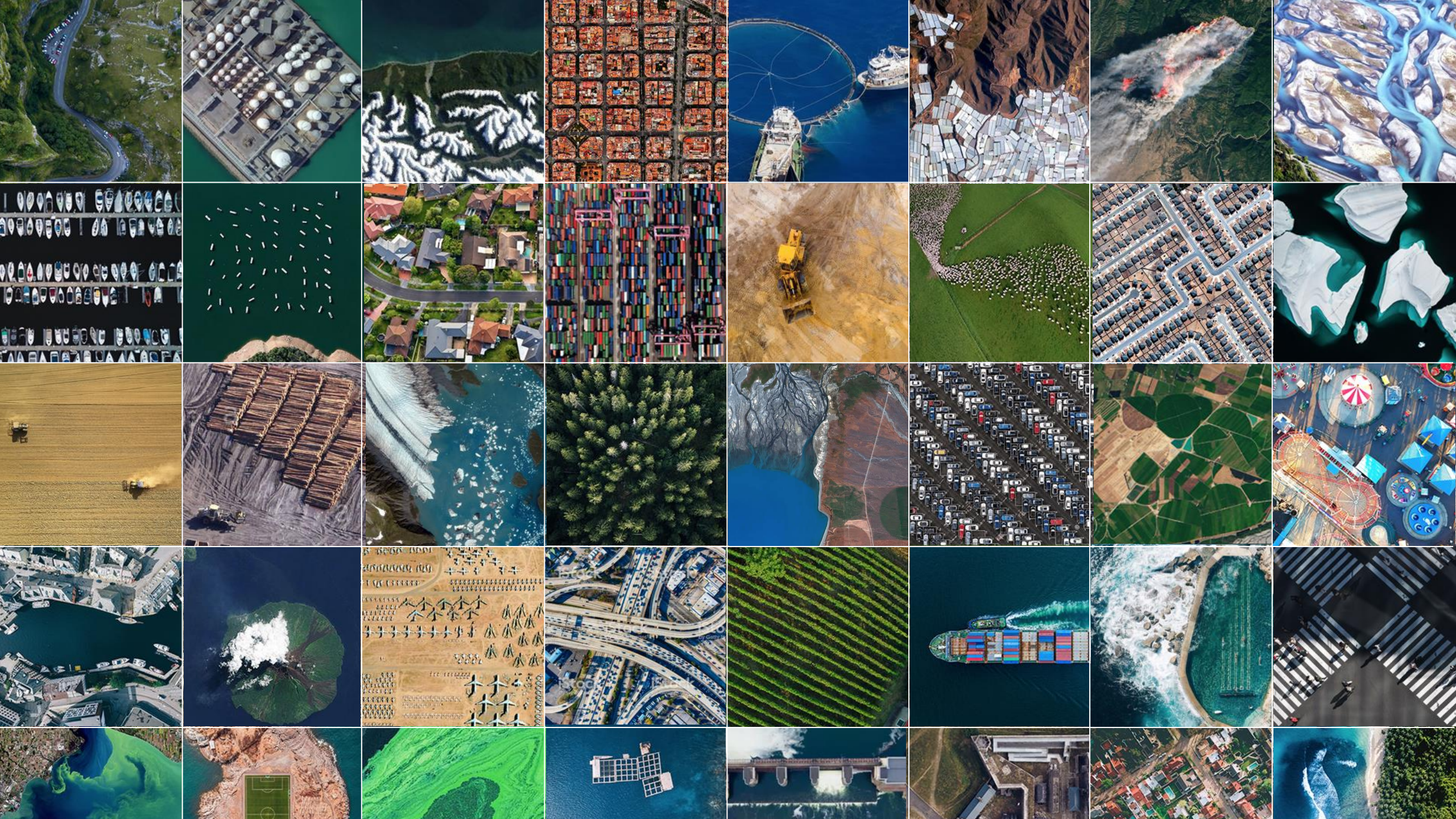
XERRA

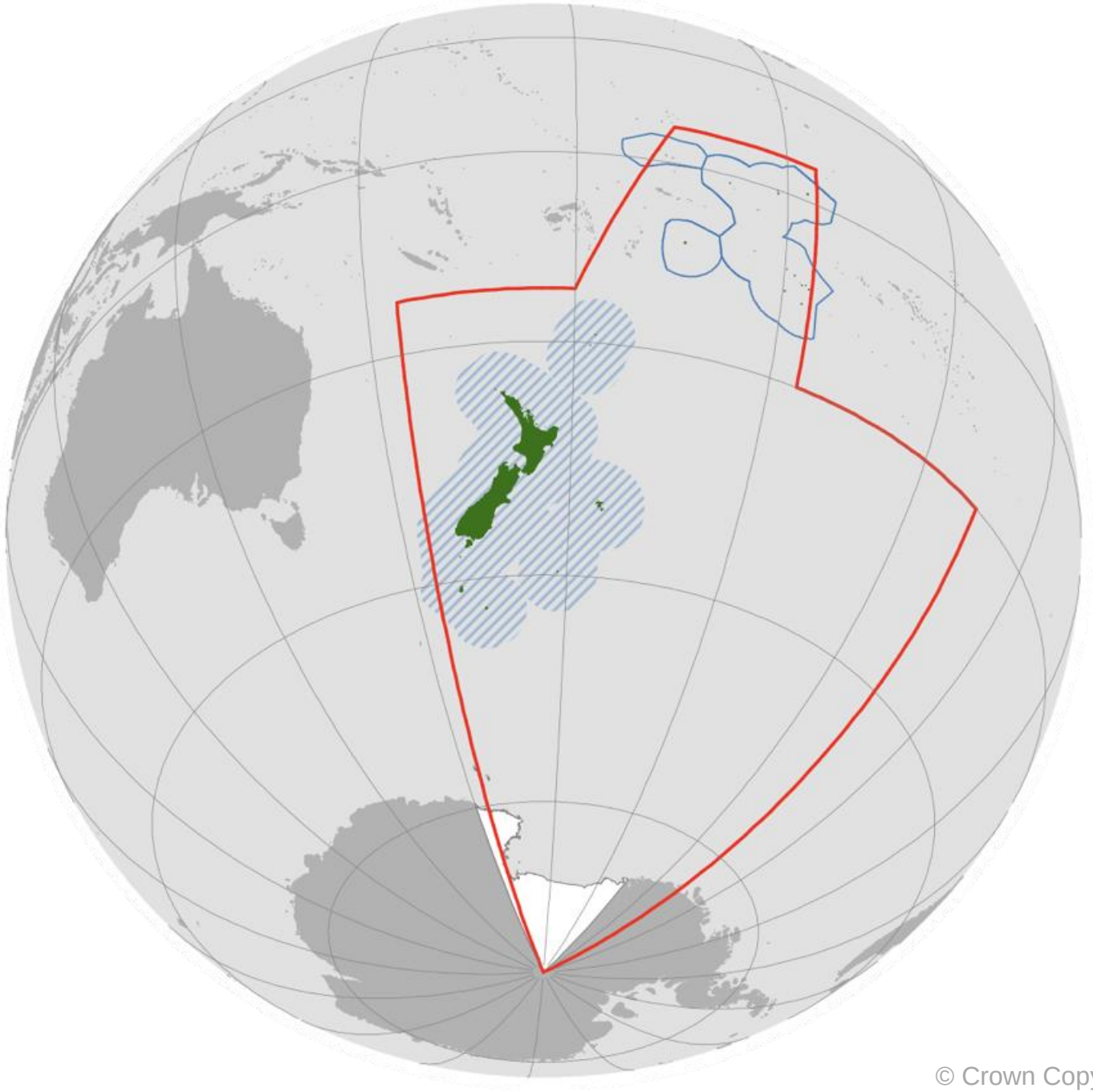
2017

GlobalStar: 7

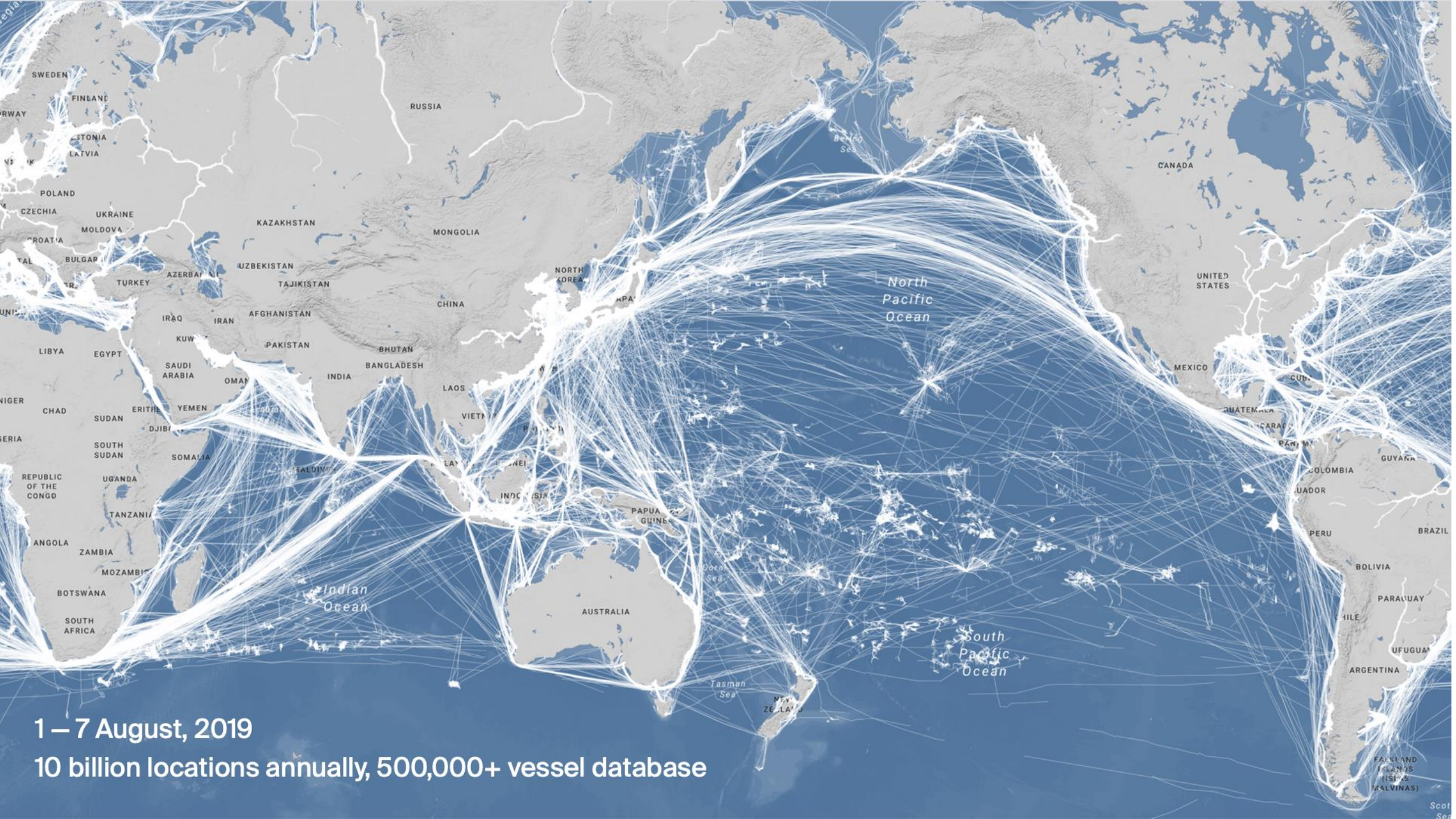








Too good to be true?



1 — 7 August, 2019

10 billion locations annually, 500,000+ vessel database

See through the chaos and focus on the activity and vessels that matter

Public health

Investigators get first look inside ship which caught on fire at Napier Port

Sophie Cornish · 19:24, Dec 24 2020

All crew are safe after a ship docked in Napier Port caught fire.

Investigators have opened up the hold of a cargo ship at Napier Port which caught on fire six days ago.

Fire and Emergency New Zealand crews opened the hold this morning, which has been closed since the fire to allow time for it to cool down.

Thursday, **19 November 2020**

Ship from Australia refused entry into Christchurch port, awaiting Covid test results

Canterbury > Christchurch

A ship was also anchored off the port of Napier last month. Photo: NZ Herald

A ship from Australia has been refused entry into a Christchurch port.

The LPG tanker Arago remains anchored near Camp Bay in Lyttelton Harbour as a Covid-19 precaution.

Covid 19 coronavirus risk stops emergency crews boarding ship in Timaru leaking liquid nitrogen

The Rio Blanco container ship is owned by AP Moller Singapore Pte Ltd.

By: Tom Dillane

Tom Dillane is a reporter at the New Zealand Herald

A huge container ship docked in Timaru had a liquid nitrogen leak with ice forming at the rear of the boat, but emergency services were unable to board because of the risk of Covid-19 among the crew.

Covid-19/Coronavirus cases

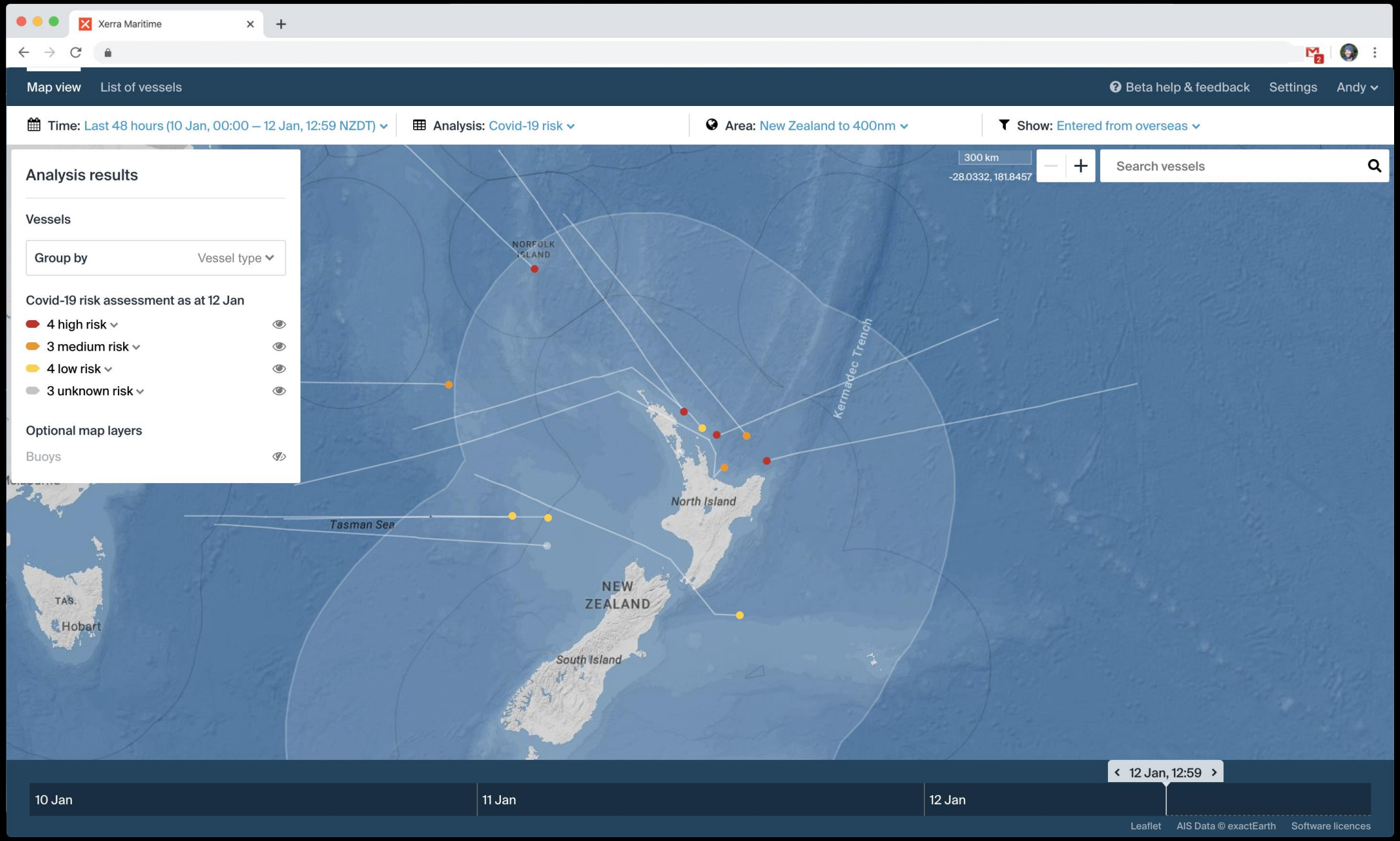
21.01.2020

Total number of reported cases

282

Data source: WHO Coronavirus disease (COVID-2019) situation reports (2020)

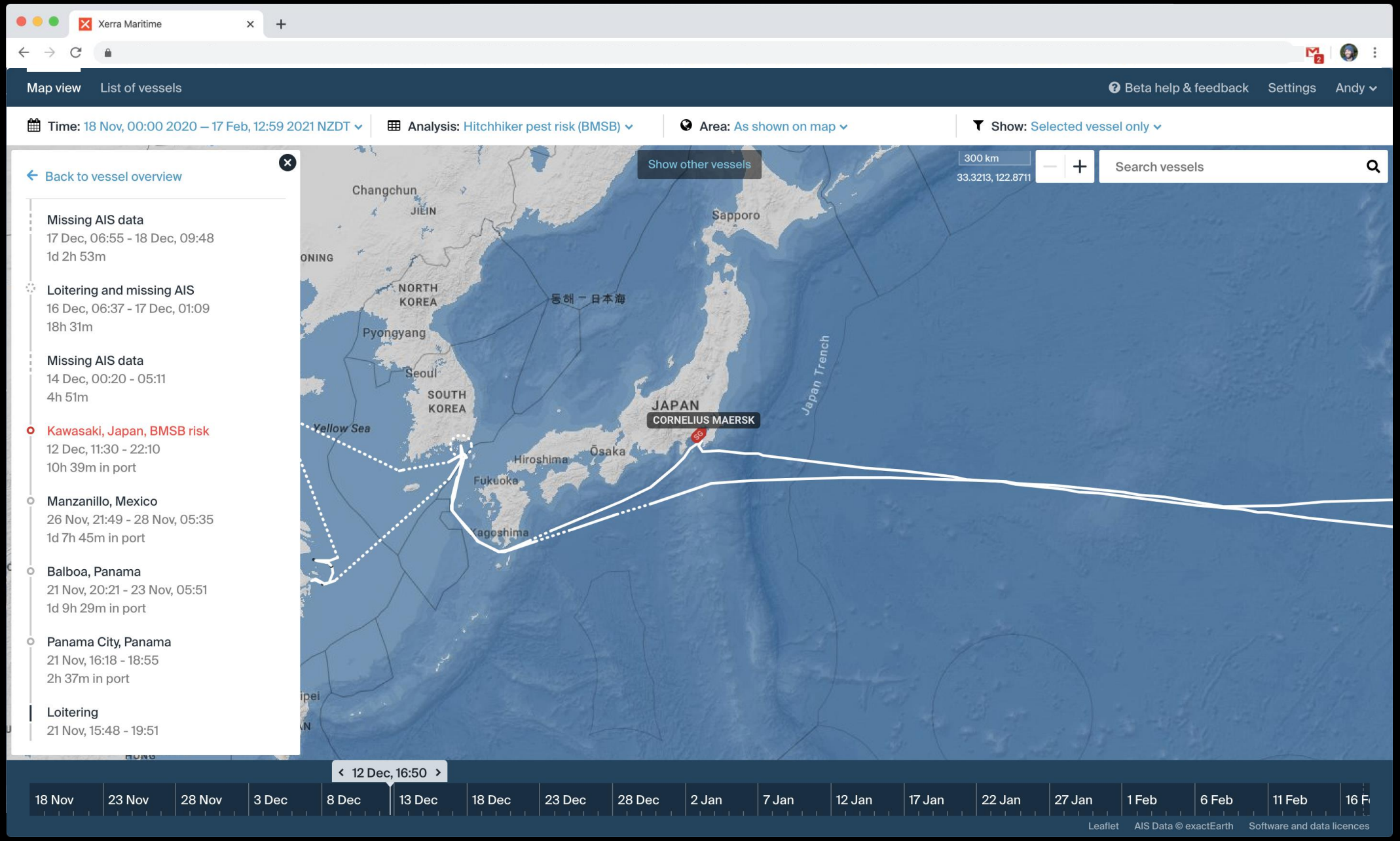
WORLD MAPPER



Vessels heading to New Zealand from international ports risk assessed for Covid-19

Biosecurity

2021 Finalist New Zealand Biosecurity Awards



Details of previous visits to hitchhiker pest risk ports during risk periods

CASE STUDY 1

Are there non-reporting vessels fishing for southern bluefin tuna in the Tasman?

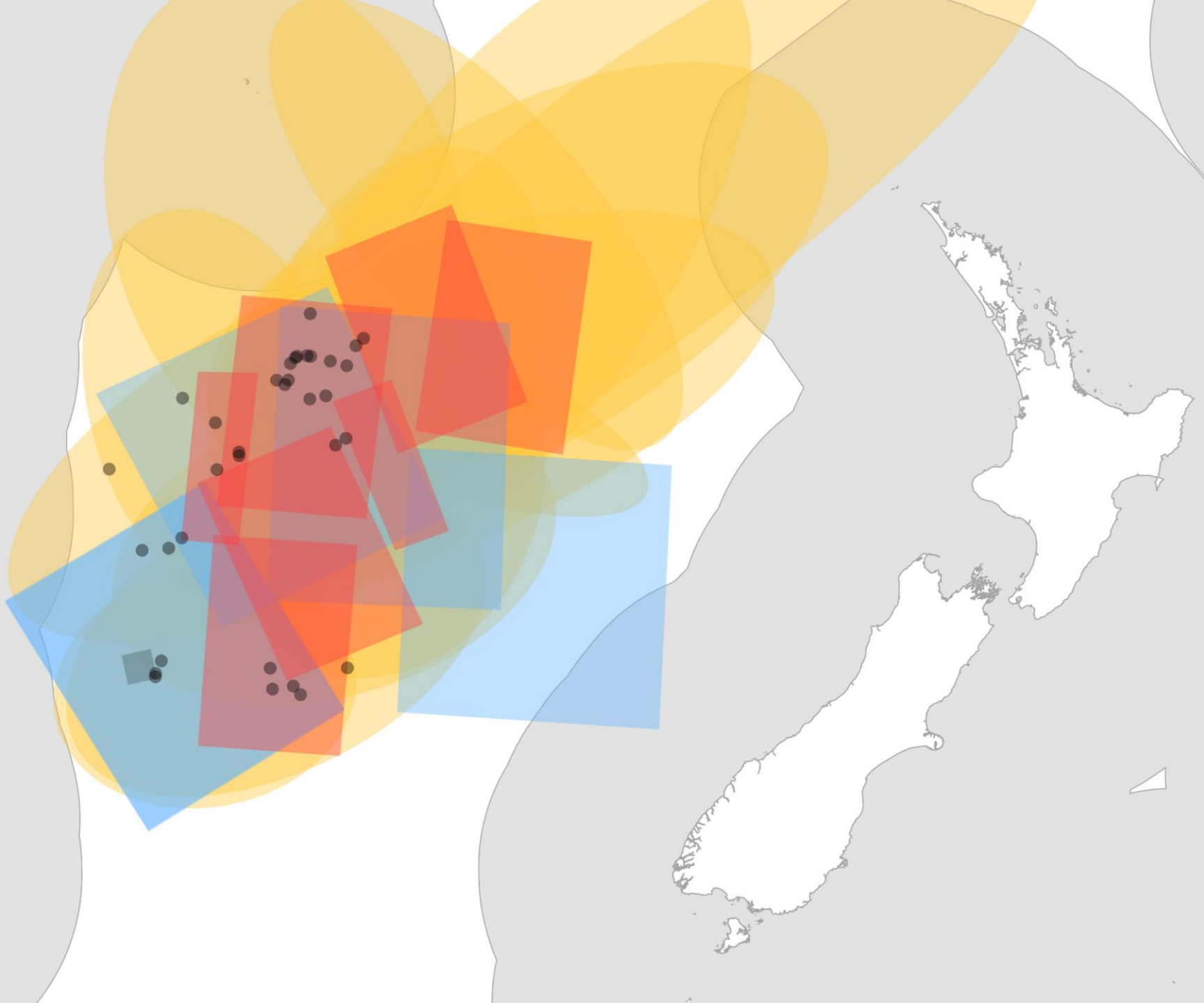
THEME

Digital operations to detect non-reporting vessels and illegal fishing

Satellite data acquisitions

- Synthetic aperture radar, Airbus
- Synthetic aperture radar, MDA
- Radio frequency, UnseenLabs
- Optical, Airbus

Combining multiple sources of satellite data in real-time provided a comprehensive picture of maritime activity



Non-classified data gathered and fused

Area of interest
2.5 million km^2

Satellite data cost
Approximately $250,000NZD

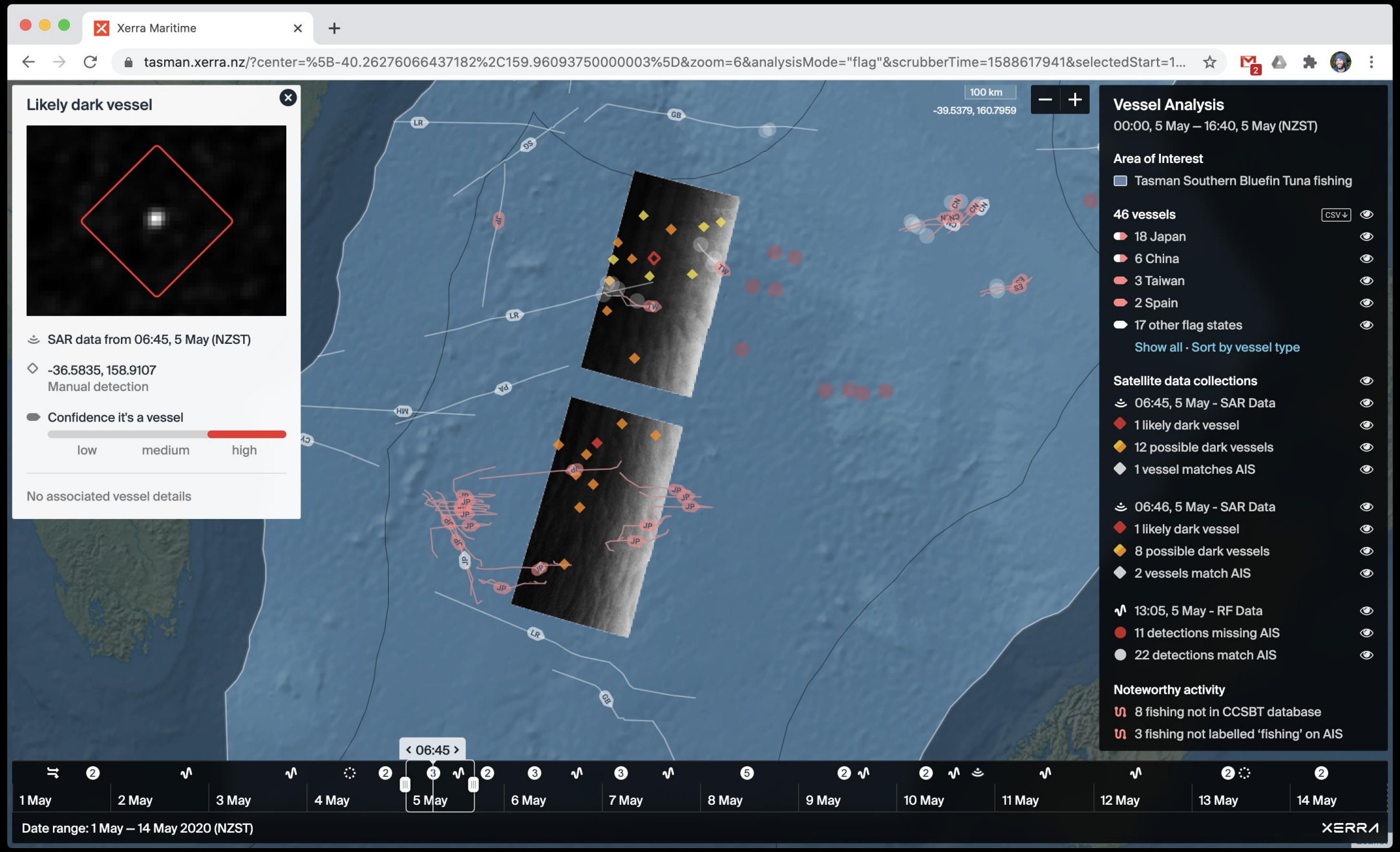
Satellite data volume
30 total collections, ~ 10.80 million km^2
14 RF collections, ~ 9.30 million km^2
11 SAR collections, ~ 1.45 million km^2
5 Optical collections, ~ 43,000 km^2

Additional data
1 P-3 flight (~$350,000NZD) with non-classified radar detections plotted

2 sources of automatic identification system (AIS) data

Regional fisheries management organisation vessel information

Sea surface temperature data from the National Oceanic and Atmospheric Administration (NOAA)



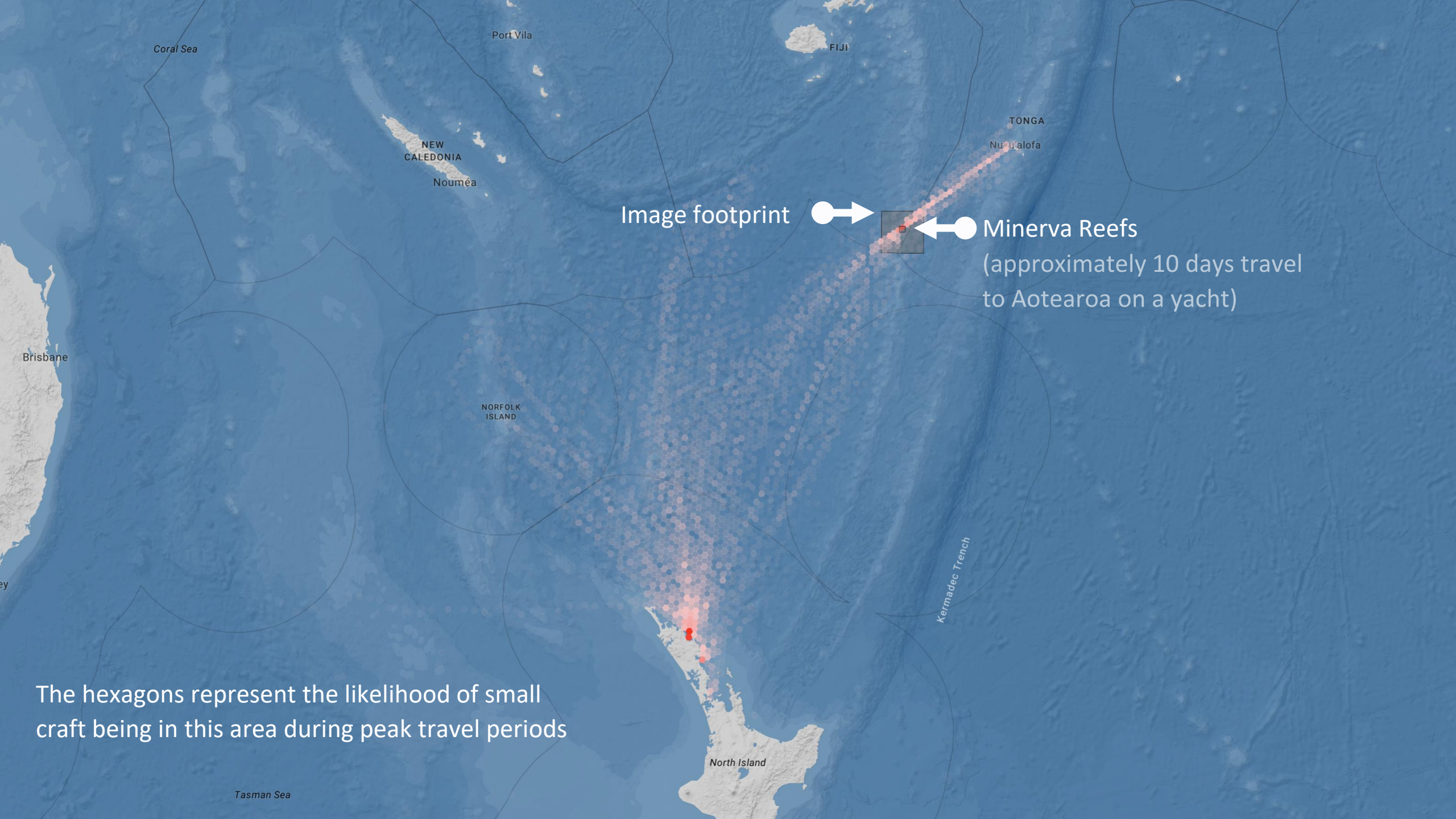
Digital operation with the New Zealand Government looking at southern bluefin tuna in the Tasman Sea

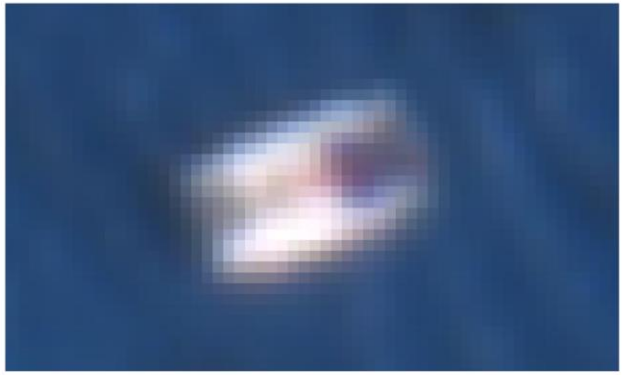
CASE STUDY 4

Detecting non-reporting small craft through historical movement analysis, and expert use of modern optical and synthetic aperture radar satellite technology

THEME

Using data analysis and high-resolution satellite data for maritime domain awareness


Coral Sea
Port Vila
FIJI
TONGA
NEW CALEDONIA
Nouméa
Image footprint
Minerva Reefs
(approximately 10 days travel to Aotearoa on a yacht)
Brisbane
NORFOLK ISLAND
Kermadec Trench
North Island
Tasman Sea
The hexagons represent the likelihood of small craft being in this area during peak travel periods



Catamaran

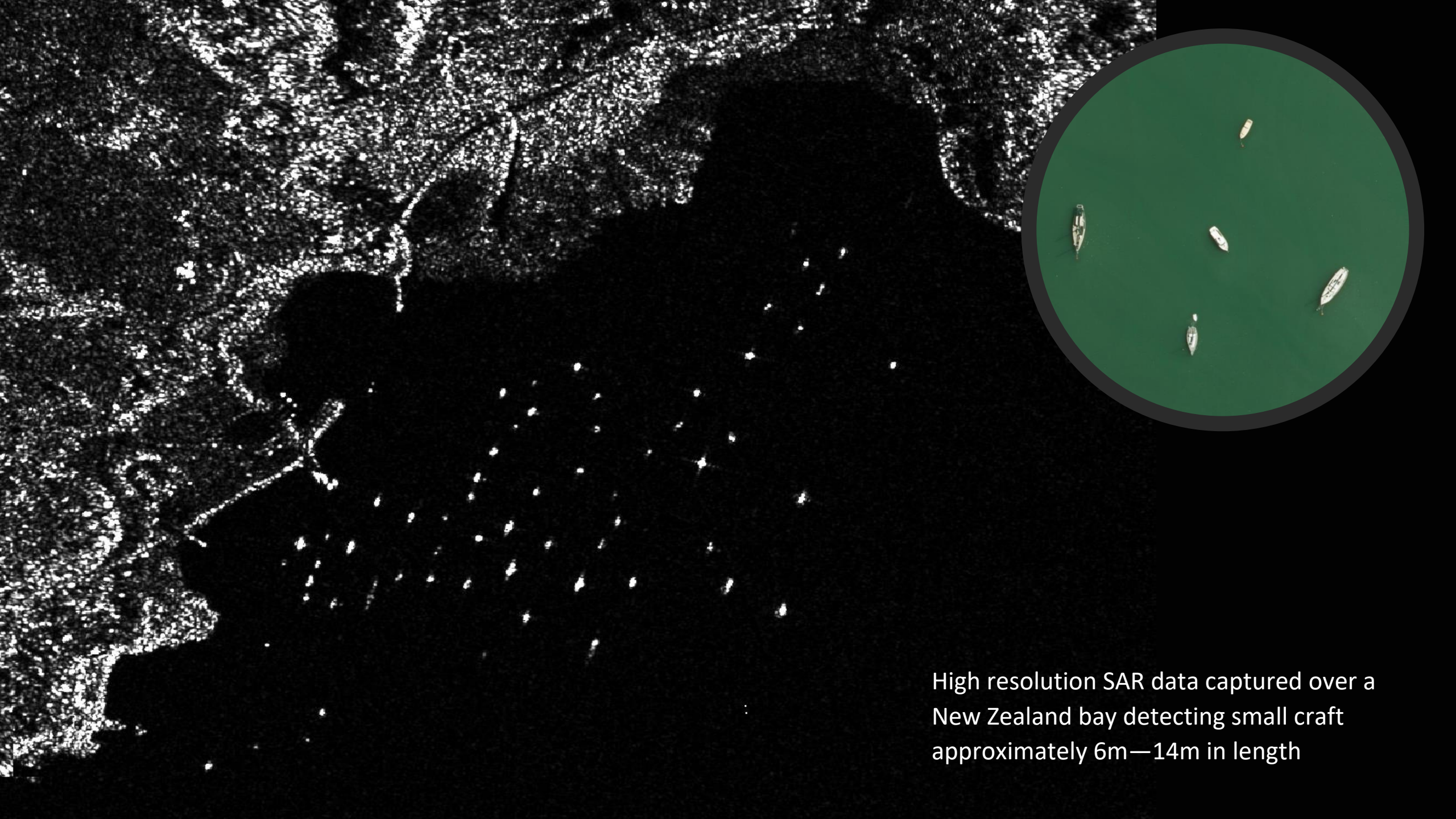
Time:
29 November 2020
00:52:32 UTC

Location:
23.65254 S, 178.93482 W

Not reporting on AIS

Length: ~10.2 m
Width: ~6.3 m

Detection of non-reporting small craft



High resolution SAR data captured over a New Zealand bay detecting small craft approximately 6m—14m in length

Kia ora, thanks for attending!

Speaker's Science Forum

Aotearoa New Zealand

Questions welcome.