MTS 2020 Virtual Symposia

An Online Series for Marine Technology Professionals

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MTS' 2020 Virtual Symposia
An Online Series for Marine Technology Professionals

- **Back by Popular Demand - Applications of Bioluminescence in Marine Technology**
  - Wednesday, May 27, 2020 – 12:00-1:00 pm (EST)
    - Edie Widder CEO, President, and Senior Scientist at the Ocean Research and Conservation Association (ORCA)

- **Underwater Mateable Connector History: The Agony and Euphoria of Their Development**
  - Wednesday, June 3, 2020 – 12:00-1:00 pm (EST)
    - James L. Cairns, Ph.D., Owner, Abyssal Systems; Executive Director, Cairns Foundation, Inc.; Founder, inventor, Ocean Design, Inc.

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MTS' 2020 Virtual Symposia
An Online Series for Marine Technology Professionals

- **Virtual Conference: Industry's Role in Seabed 2030**
  - Thursday, June 11, 2020 (Time TBD)
    - **Captain Craig McLean** (**Moderator),** Assistant Administrator for NOAA's Oceanic and Atmospheric Research (OAR) Office and Acting NOAA Chief Scientist
    - **Vladimir Ryabinin,** Executive Secretary of the Intergovernmental Oceanographic Commission (IOC) and Assistant Director General of UNESCO
    - **Jamie McMichael-Phillips,** Director, SeaBed 2030
    - **RDML Shepard Smith**, Director of NOAA's Office of Coast Survey and US National Representative to the International Hydrographic Organization (IHO)
    - **Jyotika Virmani,** Executive Director of Schmidt Ocean Institute
    - **Mike Read,** President, Teledyne Marine
    - **Bjørn Jalving,** Senior Vice President Technology, Sensors & Robotics, Kongsberg Maritime
    - **David Millar,** Government Accounts Director, Americas, Fugro
    - **Rick Spinrad**, President, Marine Technology Society

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Introducing The SeaBed 2030 Initiative

- Vladimir Ryabinin, Executive Secretary of the Intergovernmental Oceanographic Commission (IOC) and Assistant Director General of UNESCO
  Setting the Stage for Nations to Join Forces in Mapping the Ocean

- Jamie McMichael-Phillips, Director, Seabed 2030
  Private Sector NGOs and Philantropic Foundations Joining Together to Tackle SeaBed 2030

- RDML Shepard Smith, Director, NOAA Coast Survey
  Industry's Role in Rising to the SeaFloor 2030 Challenge

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Setting the Stage for Nations to Join Forces in Mapping the Ocean

Dr. Vladimir Ryabinin
Executive Secretary,
Intergovernmental Oceanographic Commission of UNESCO
Assistant Director General, UNESCO

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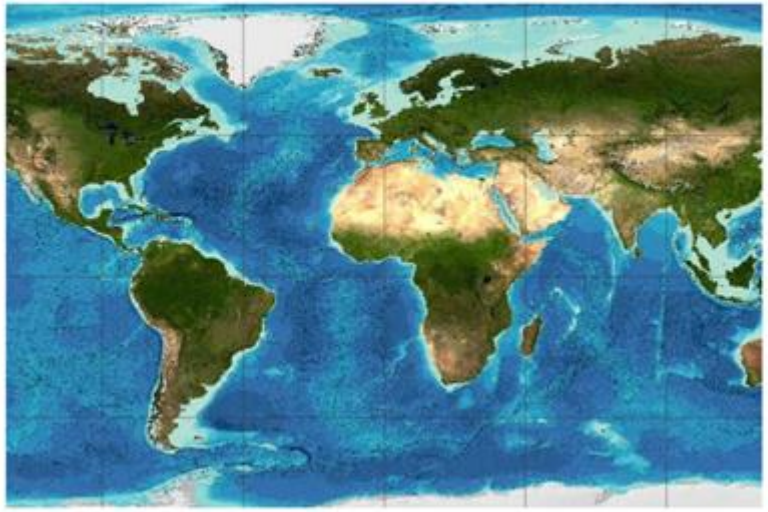
Parenthood

Intergovernmental Oceanographic Commission of UNESCO (IOC, 1960-)
International Hydrographic Organization (IHO, 1921-)
General Bathymetric Chart of the Oceans (IHO/IOC GEBCO, 1903-)

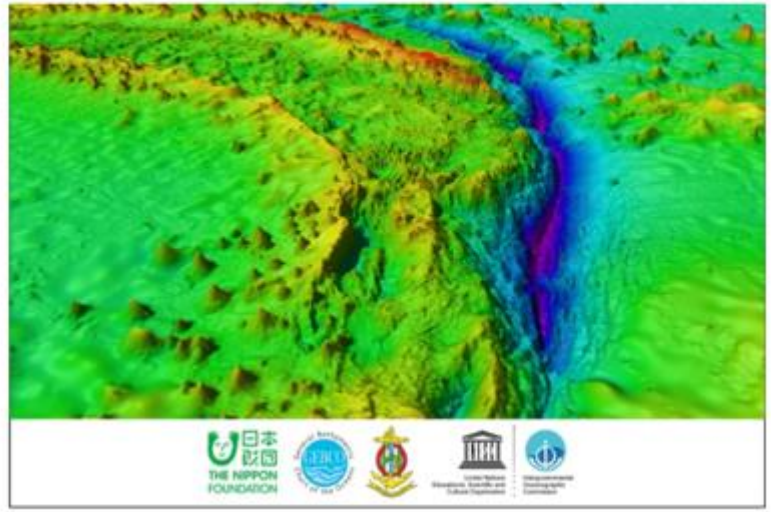
GEBCO - Nippon Foundation

Gridded Bathymetry Data

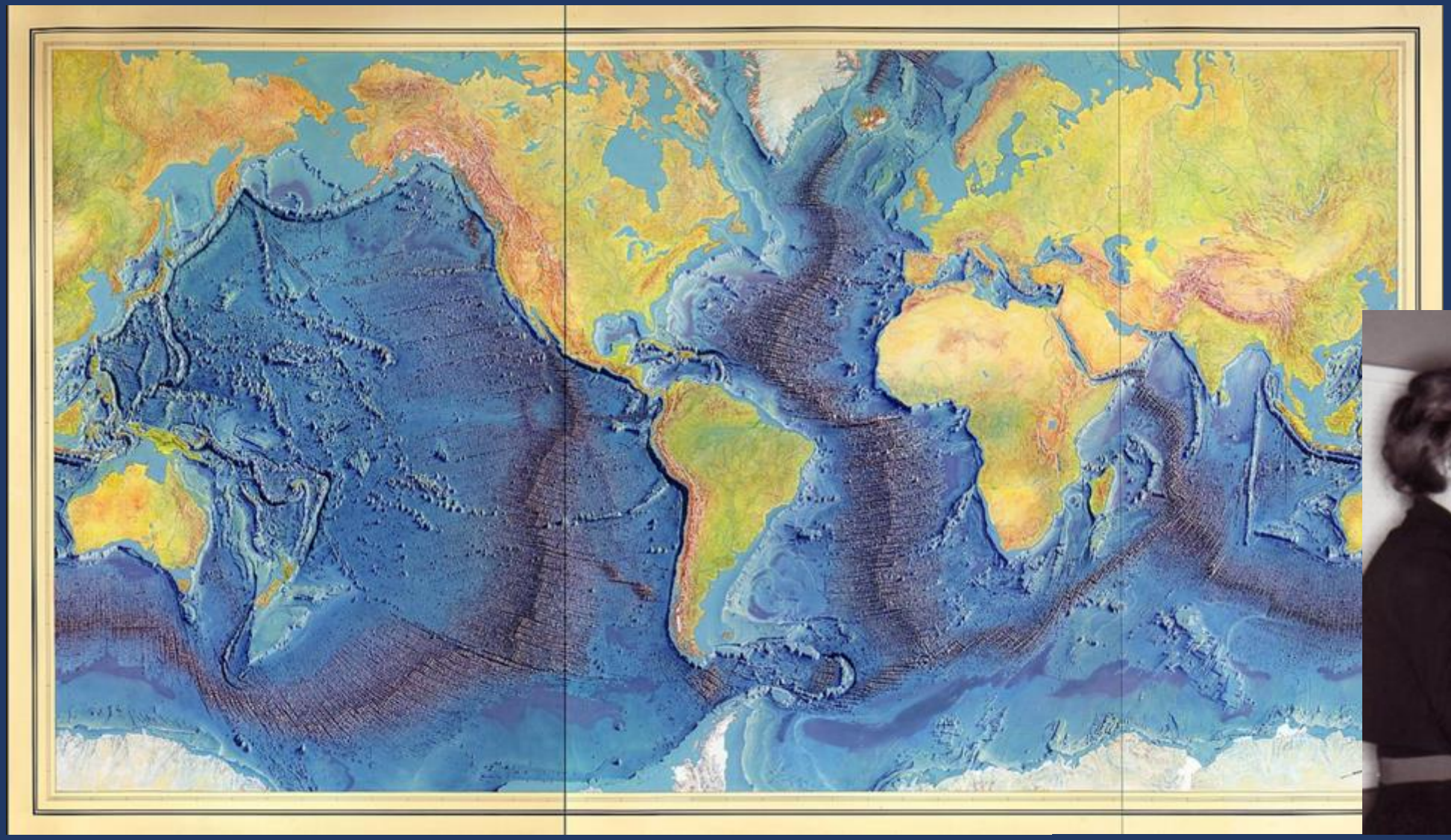


Data & Products

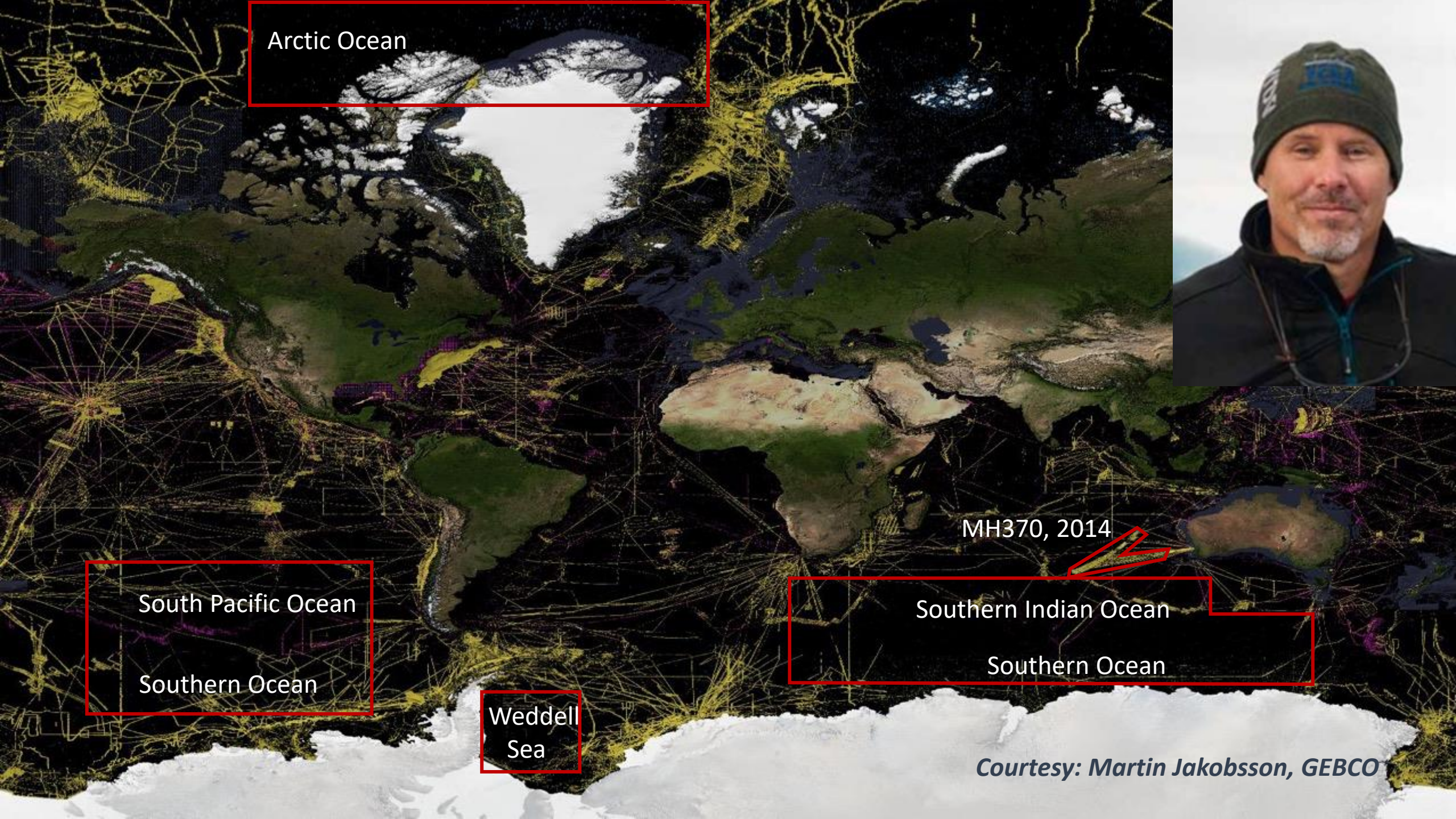
Seabed 2030



1st Global Map of Ocean Depth (1977)



Marie Tharp and Bruce Heezen. Image from flickr.com



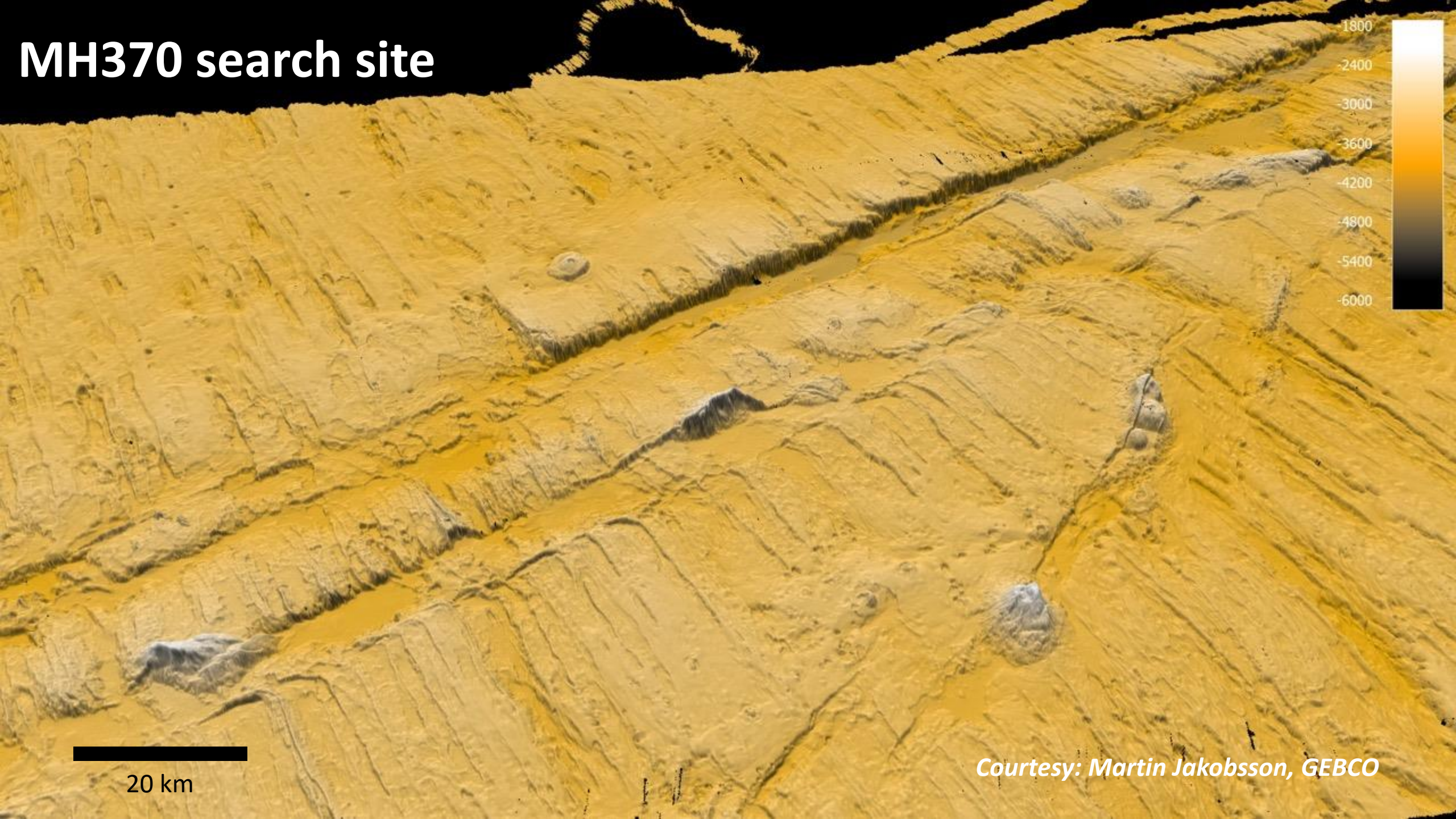
Courtesy: Martin Jakobsson, GEBCO

~~The Ocean Frontiers!~~

No, Mars …

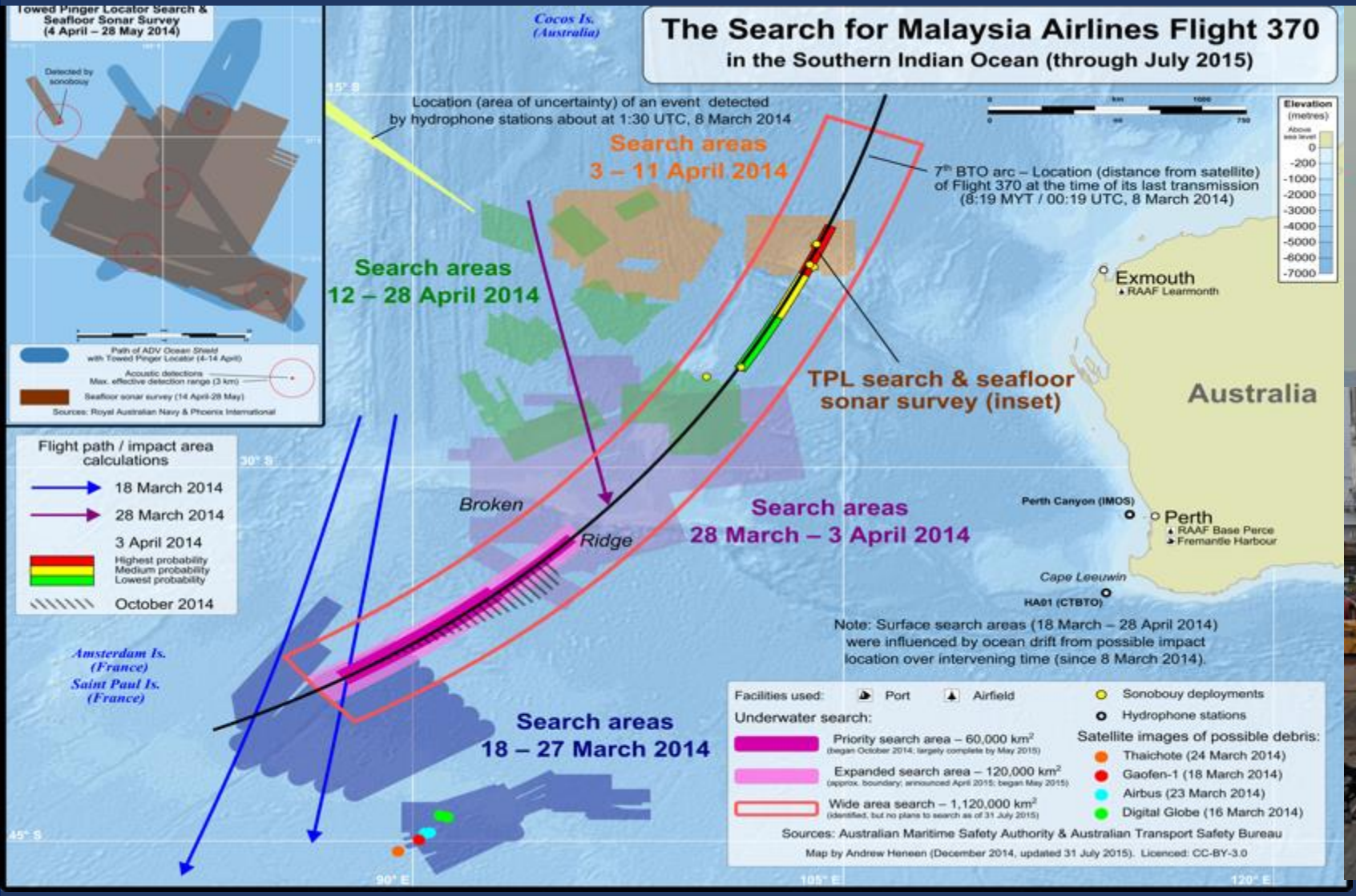
Courtesy: Martin Jakobsson, GEBCO

MH370 search site



Courtesy: Martin Jakobsson, GEBCO

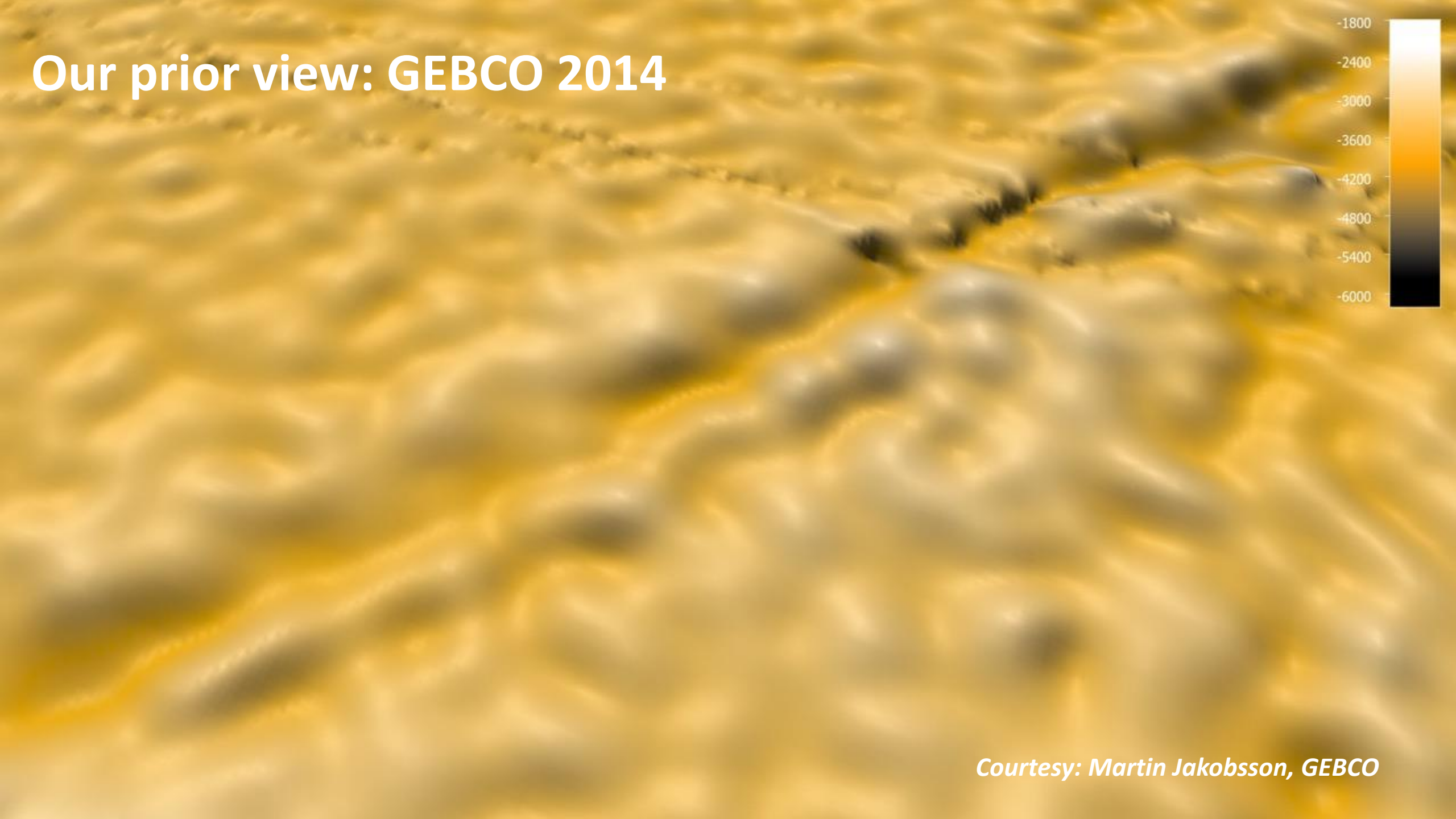
Ocean Depth (MH370 search)



From Wikipedia

Photo U.S. Navy

Our prior view: GEBCO 2014

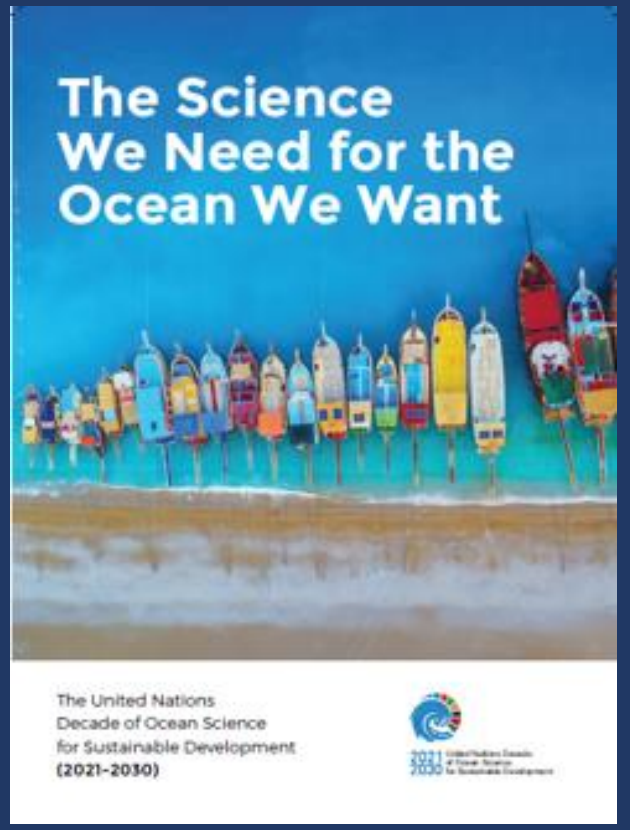


Courtesy: Martin Jakobsson, GEBCO

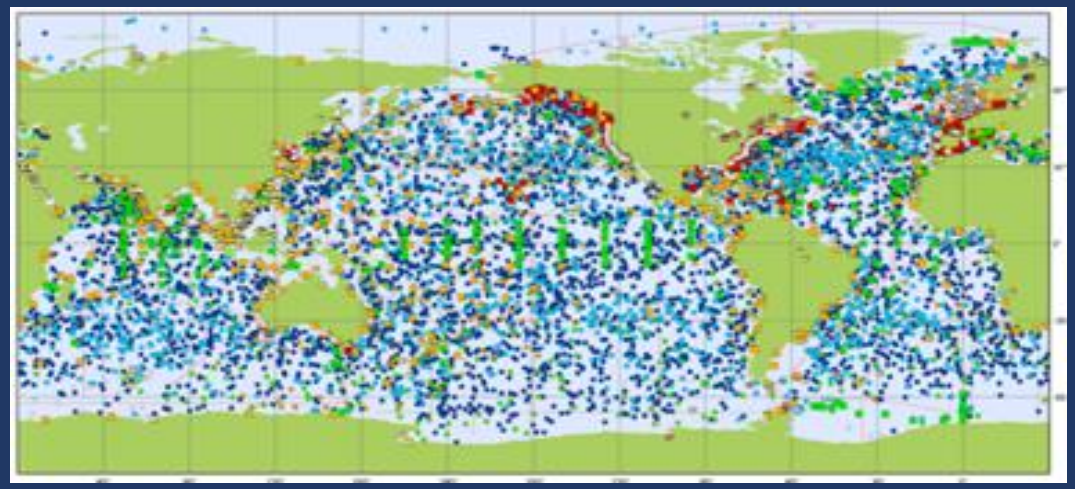
GENERAL ASSEMBLY OF THE UNITED NATIONS

UN Decade of Ocean Science for Sustainable Development (2021-2030)

2021 2030 United Nations Decade of Ocean Science for Sustainable Development



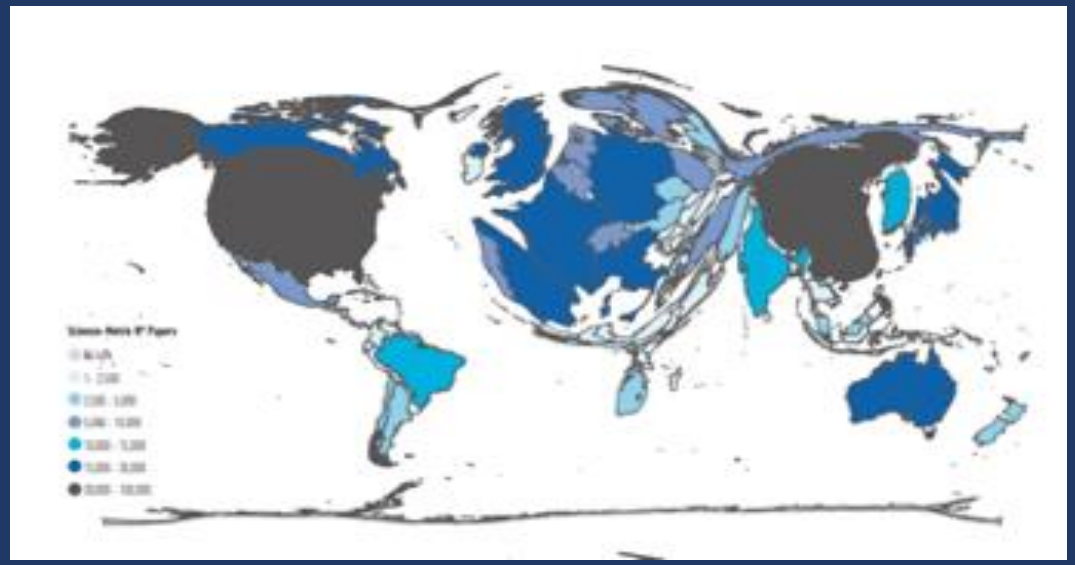
Observing



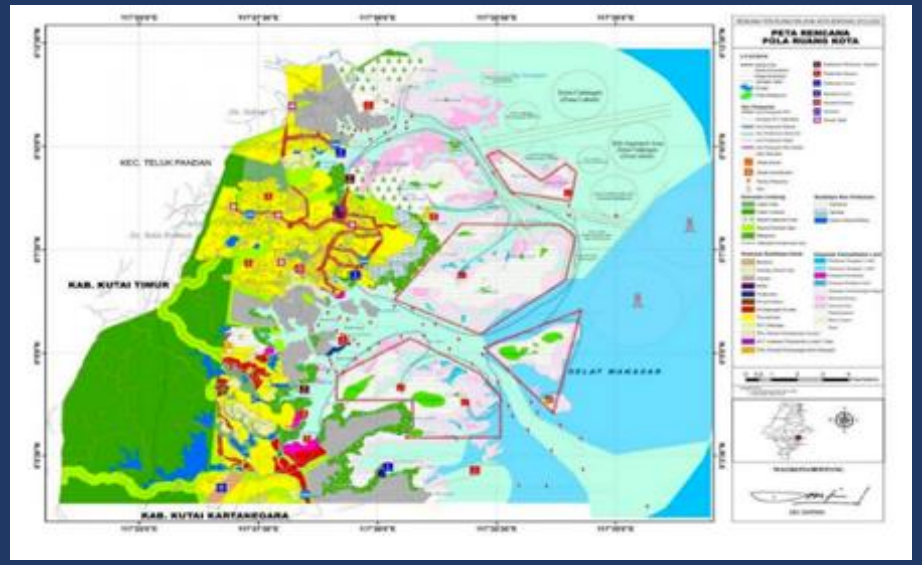
Understanding

Predicting

Capacitating



Managing



100% of the ocean floor mapped by 2030

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The Nippon Foundation-GEBCO

Seabed 2030 Project

Jamie McMichael-Phillips – Project Director

THE NIPPON FOUNDATION

General Bathymetric Chart of the Oceans GEBCO

IHO International Hydrographic Organization

UNESCO United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

GEBCO

GEBCO Guiding Committee

‘ The **Ge**neral **B**athymetric **C**hart of the **O**cean’

‘… a joint project of **IHO** & **IOC**, managed by the GEBCO Guiding Committee (GGC)’

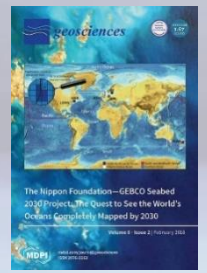
‘…aiming to provide the most authoritative, publicly-available bathymetry data sets of the world’s oceans.’

‘… largely a **voluntary** community of international **scientists** and **hydrographers** collaborating with the support of their parent organizations.’

SEABED 2030

A collaborative project between The Nippon Foundation and GEBCO to inspire the complete mapping of the world's ocean by 2030 and to compile all bathymetric data into the freely-available GEBCO Ocean Map.

Forum for Future Ocean Floor Mapping



THE OCEAN CONFERENCE
UNITED NATIONS, NEW YORK, 5-9 JUNE 2017

June 2016

June 2017

Seabed 2030 Management

Management

Seabed 2030 Project Team

Seabed 2030 reports to GEBCO Guiding Committee

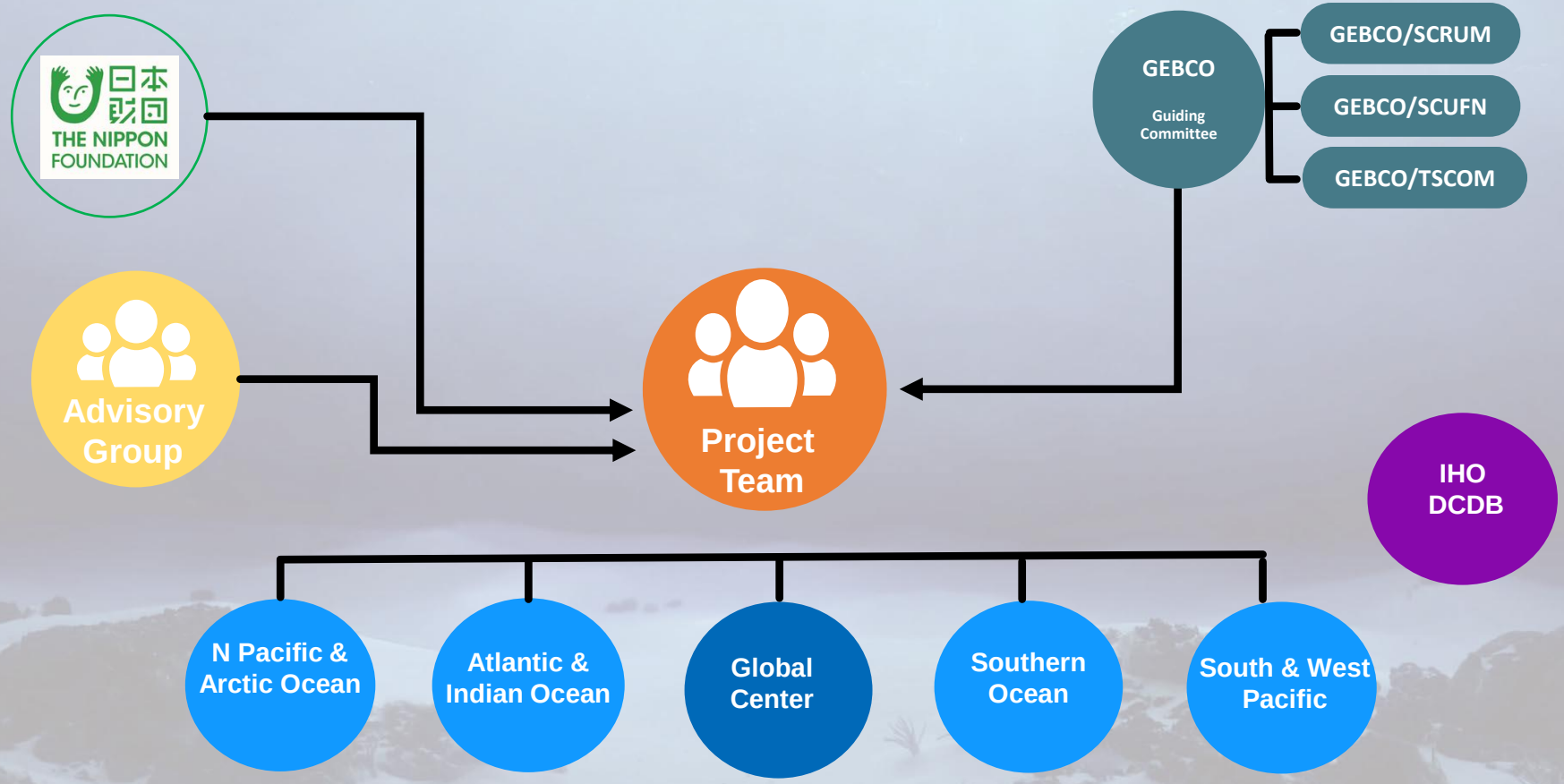
Leadership

- The Nippon Foundation

&

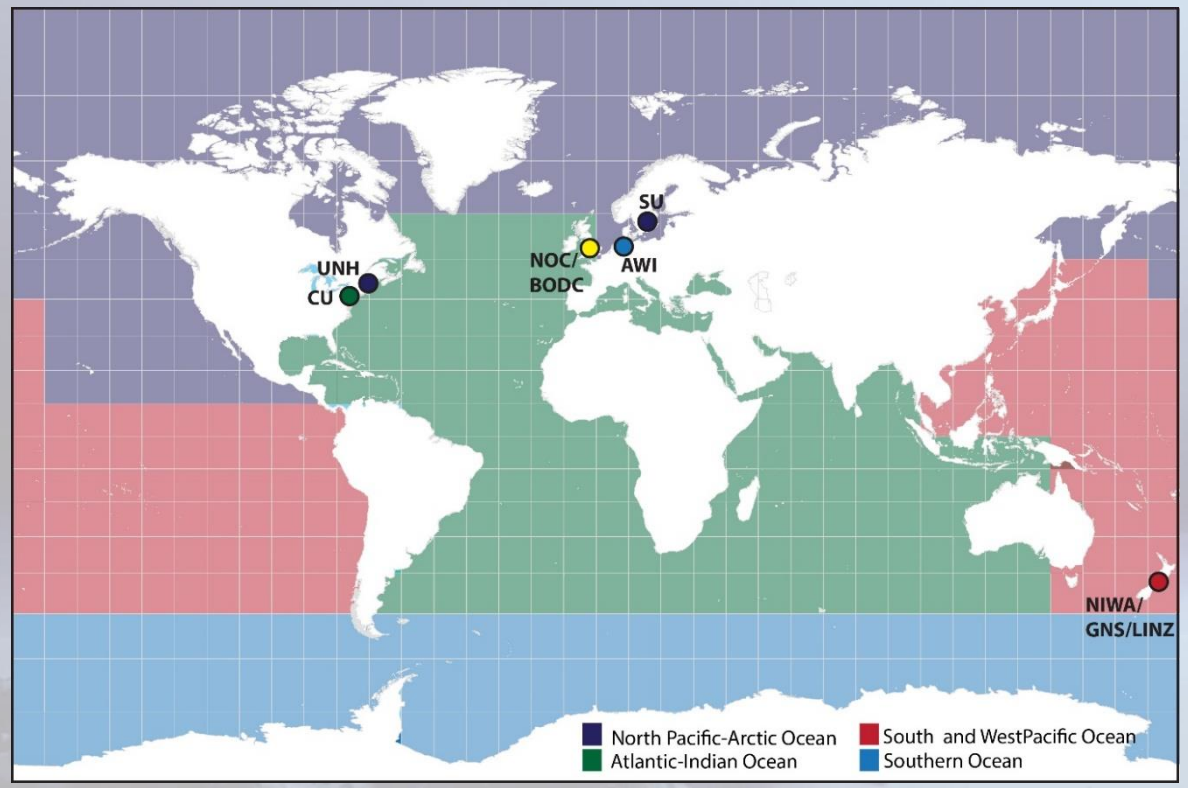
- GEBCO under the auspices of IHO and IOC

Seabed 2030 Network



4 Regional Centers + 1 Global Center

The Network of Centers



North Pacific –Arctic Ocean
Stockholm University & University of New Hampshire
(**SU** & **UNH**)

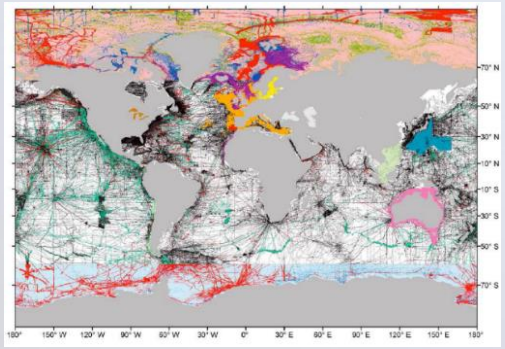
Southern Ocean
Alfred-Wegener-Institut (**AWI**)

Atlantic-Indian Ocean
Lamont-Doherty Earth Observatory,
Columbia University (**CU**)

South-West Pacific Ocean
National Institute of Water & Atmospheric Research (**NIWA**)
Land Information New Zealand (**LINZ**)
GNS Science (**GNS**)

Global Center
British Oceanographic Data Centre,
National Oceanography Centre (**NOC/BODC**)

Seabed 2030 Phase 1 Existing Data



GEBCO 2014
30-arc second Grid

- Ingest all available existing data (Y)
- Catalogue embargoed existing data (Y)
- Develop new high-res GEBCO product
- Develop user tools for GEBCO products

$$X + \mathbf{Y} + Z = 100\%$$

Data IN GEBCO

Data NOT in GEBCO

'Map the Gaps' = ocean NOT mapped

Seabed 2030 Phase 2: Mapping the Gaps

$$X + Y + \mathbf{Z} = 100\%$$

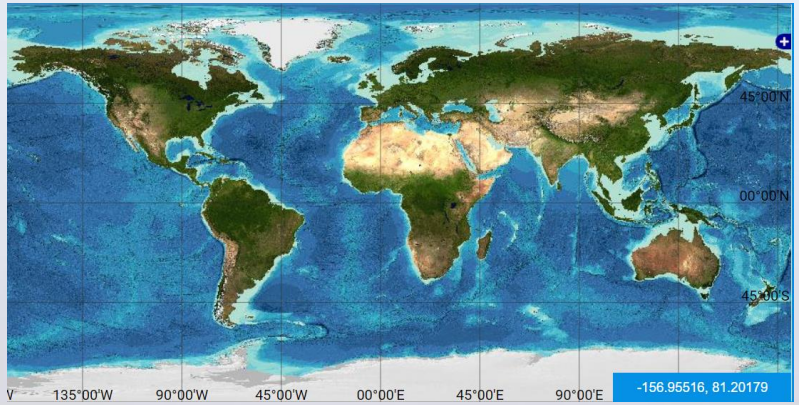
- **Ocean Frontier Mapping**
  - Use GEBCO Grid to inform location of future mapping
  - Advocate for greater mapping activity
  - Identify funding for mapping expeditions
- **Crowd Sourced Bathymetry**
  - Promoting CSB around the world
  - Gaining support of, and data from, contributors at all levels
- **Technology Innovation**
  - What can Seabed 2030 do to accelerate uptake of technology to accelerate rate of bathymetric mapping?

GEBCO-NF ALUMNI

Shell OCEAN DISCOVERY XPRIZE

Why Now?

The **need**: Ocean under stress



2021 2030 United Nations Decade of Ocean Science for Sustainable Development

14 LIFE BELOW WATER

UN SDG-14

Big Data

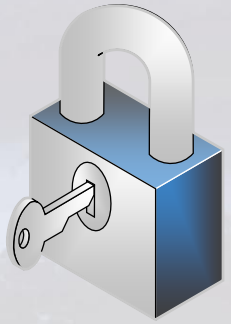
The Cloud

IoT

Information Technology

Solutions: innovation

Autonomy



Open Data

What we ask of you ……..

- ***Noting*** that

  - Some 70% of the Earth covered by the ocean, yet today we have mapped only ~ 15%

  - Seabed shape is fundamental not only to safety of navigation but also to many ocean processes that:
    - Drive ocean current circulation, affecting climate & sea level rise predictions.
    - Allow forecasting of tsunami wave propagation & other dynamic phenomena (inc sediment transportation; wave action; & underwater hazards).
    - Allow better understanding of marine habitats, eco-systems and much more
    - Offer opportunities for new discoveries …….

- ***Please ……..***

What we ask of you ……..

- ***Please join us in supporting*** **Seabed 2030 by:**
  - Promoting the vital need to map the entire seabed
  - Encouraging your own organisations and clients to make existing seabed mapping data available for use by Seabed 2030 in the GEBCO Grid
    - *Non commercially sensitive/sanitised data if possible*
    - *Transit data between projects*
  - Helping us gather Crowd Sourced Bathymetry (CSB) for use by Seabed 2030 in the GEBCO Grid
  - Supporting future seabed mapping projects where data can be used by Seabed 2030 in the GEBCO Grid
  - Innovating technology that will accelerate seabed mapping

Thank you

Sponsors:

THE NIPPON FOUNDATION

IHO International Hydrographic Organization

UNESCO United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

Regional and Global Center hosts:

University of New Hampshire

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Lamont-Doherty Earth Observatory
COLUMBIA UNIVERSITY | EARTH INSTITUTE

Stockholm University

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

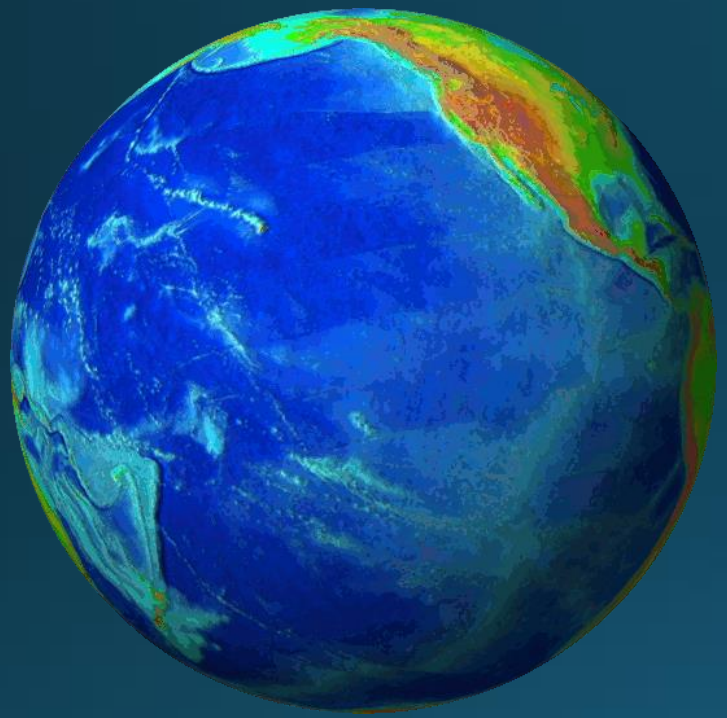
NIWA Taihoro Nukurangi

GNS Science

Land Information New Zealand

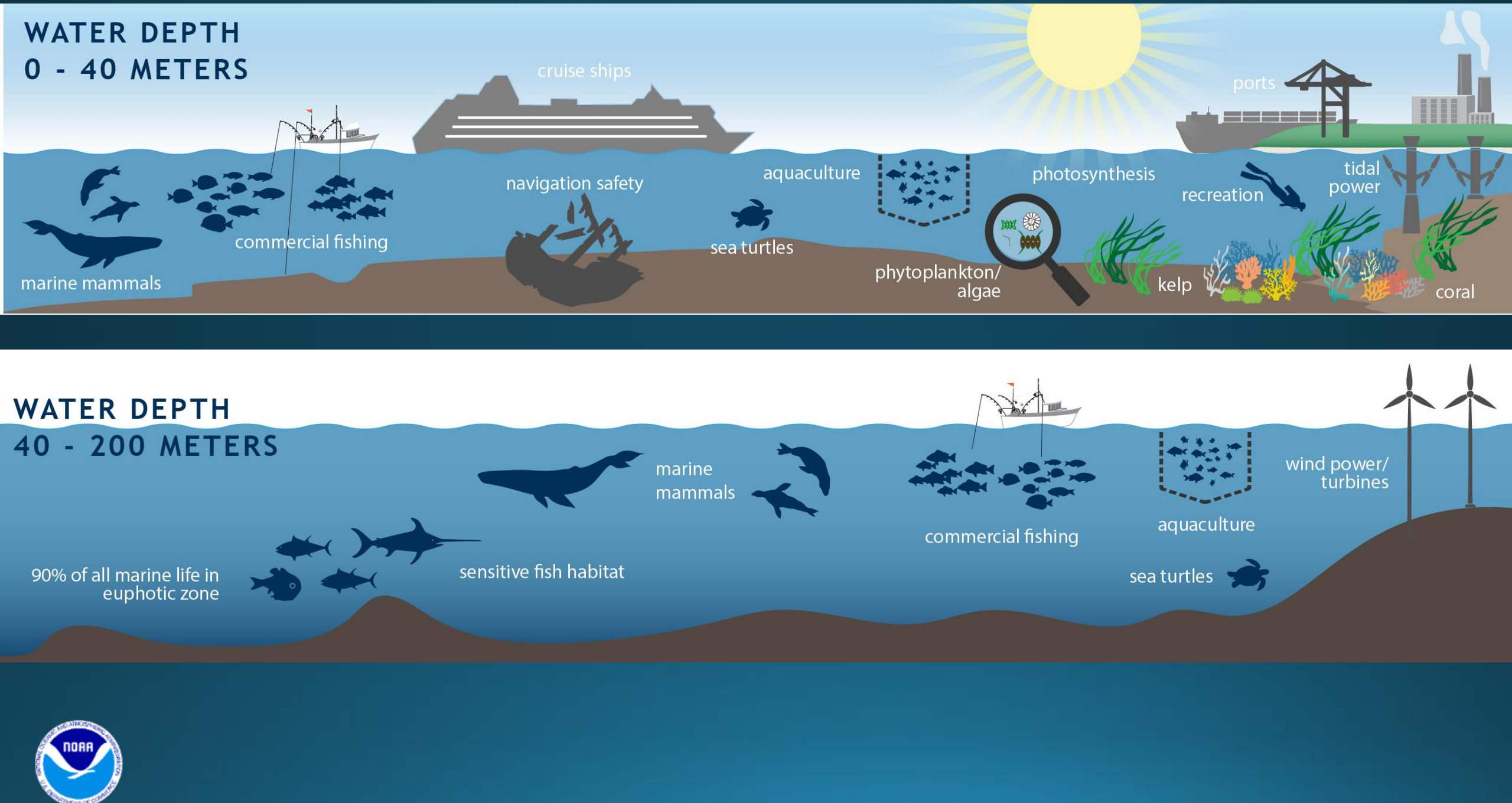
Connect with Seabed 2030:

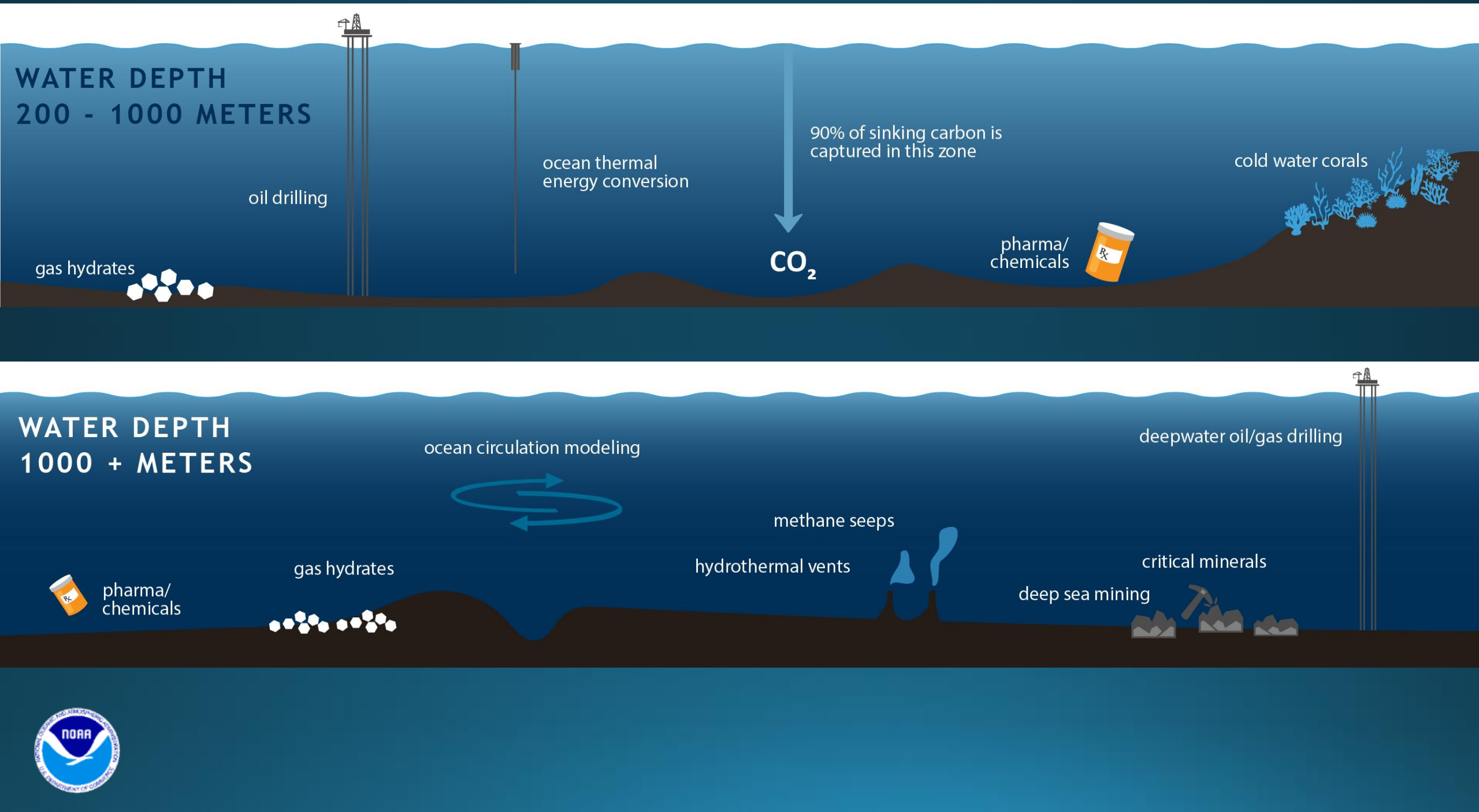
https://seabed2030.gebco.net/get_involved/



Industry Role in Seabed 2030

Rear Admiral Shepard M. Smith
National Oceanic and Atmospheric Administration


WATER DEPTH
0 - 40 METERS
cruise ships
ports
navigation safety
aquaculture
photosynthesis
recreation
tidal power
commercial fishing
sea turtles
marine mammals
phytoplankton/ algae
kelp
coral
WATER DEPTH
40 - 200 METERS
marine mammals
commercial fishing
aquaculture
wind power/ turbines
sensitive fish habitat
sea turtles
90% of all marine life in euphotic zone

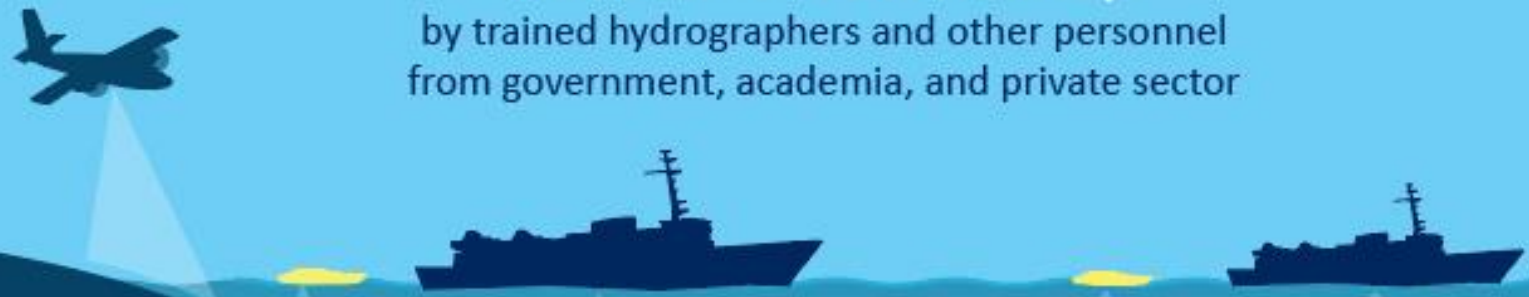

WATER DEPTH
200 - 1000 METERS
oil drilling
ocean thermal
energy conversion
90% of sinking carbon is
captured in this zone
cold water corals
gas hydrates
CO_2
pharma/
chemicals
WATER DEPTH
1000 + METERS
ocean circulation modeling
deepwater oil/gas drilling
methane seeps
gas hydrates
hydrothermal vents
critical minerals
pharma/
chemicals
deep sea mining

Mapping the Seafloor

primary sources of bathymetry

Multibeam and LIDAR surveys

by trained hydrographers and other personnel
from government, academia, and private sector



Coastline

Representing ~0-40 meters water depth, mapping in this area is ideal for aircraft using LIDAR technology and autonomous systems using multibeam sonar technology. Concerns about safe navigation require a high level of data accuracy.

Shallow water

Representing ~40-200 meters water depth, mapping this area is ideal for ships using multibeam sonar technology alongside autonomous systems as a force multiplier. Conditions are not usually suitable for aerial survey methods. Concerns about safe navigation require a high level of data accuracy.

Deep water

Representing water depths >200 meters, mapping this area is ideal for ships using multibeam sonar technology. Conditions are not suitable for aerial survey methods and navigation safety is not a primary concern in this area.

unmanned

other sources

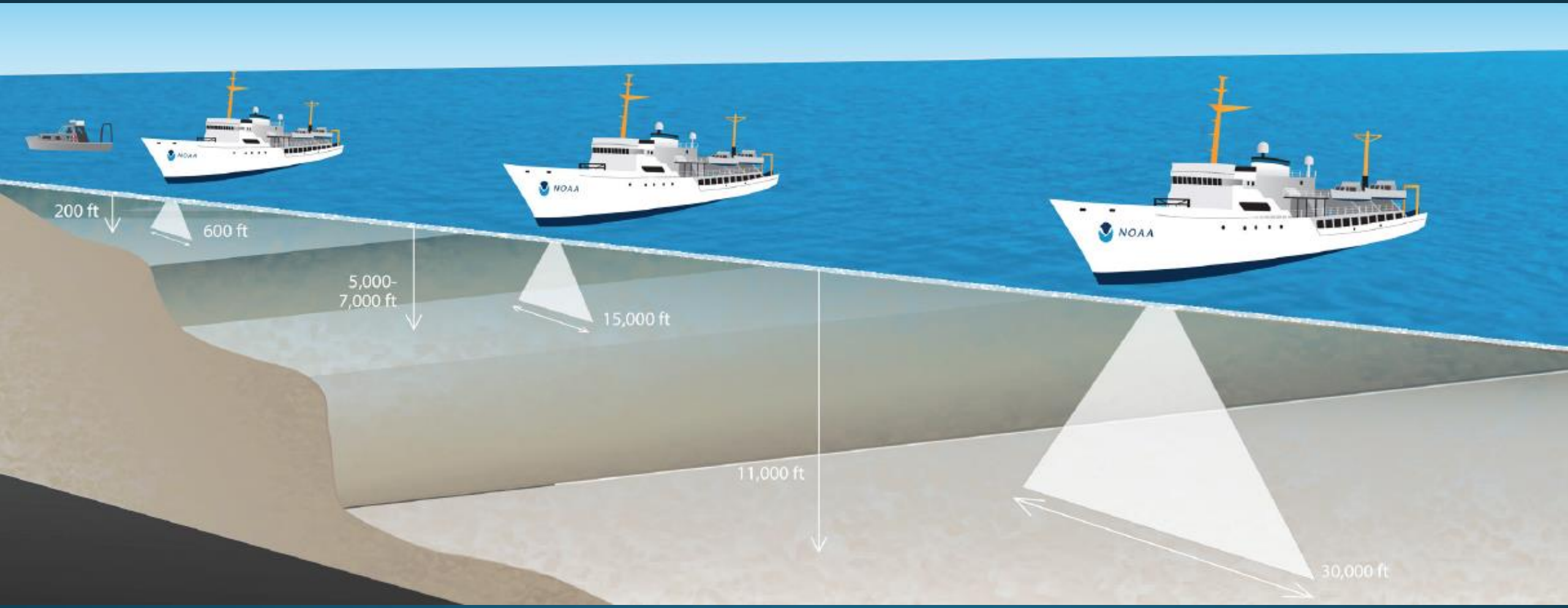
Unmanned aerial vehicles

Satellite-derived bathymetry

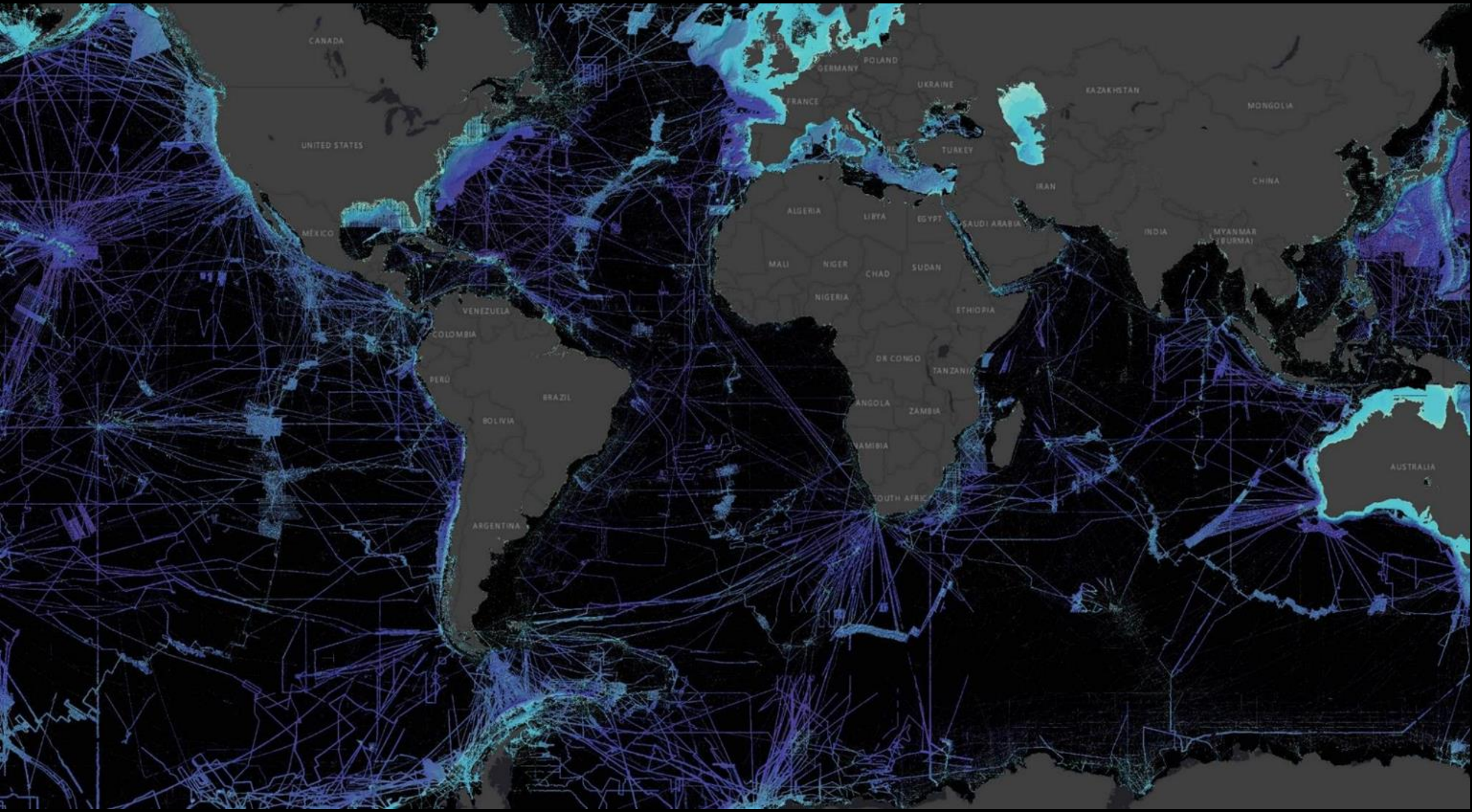
Sidescan sonar

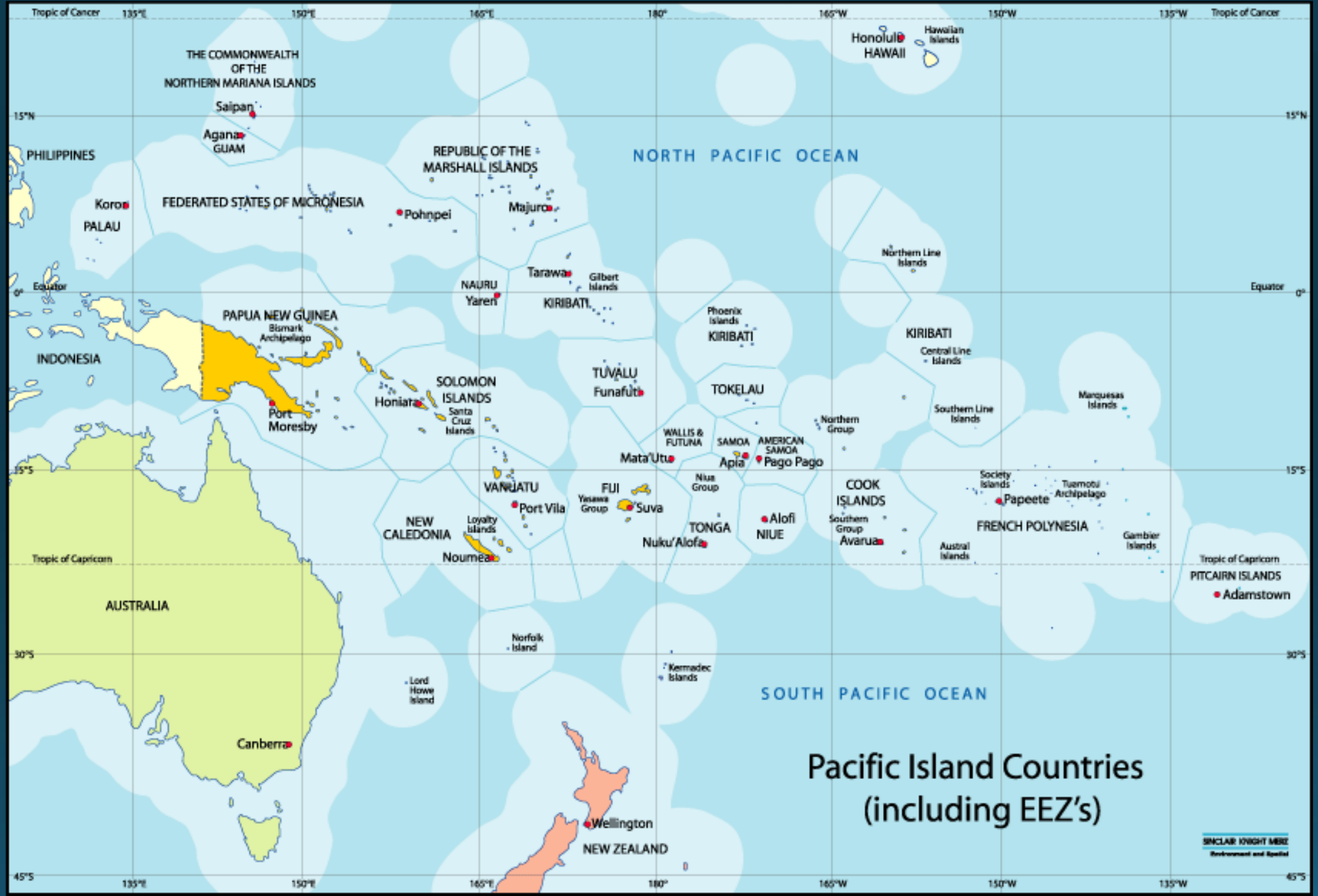
Single beam bathymetry

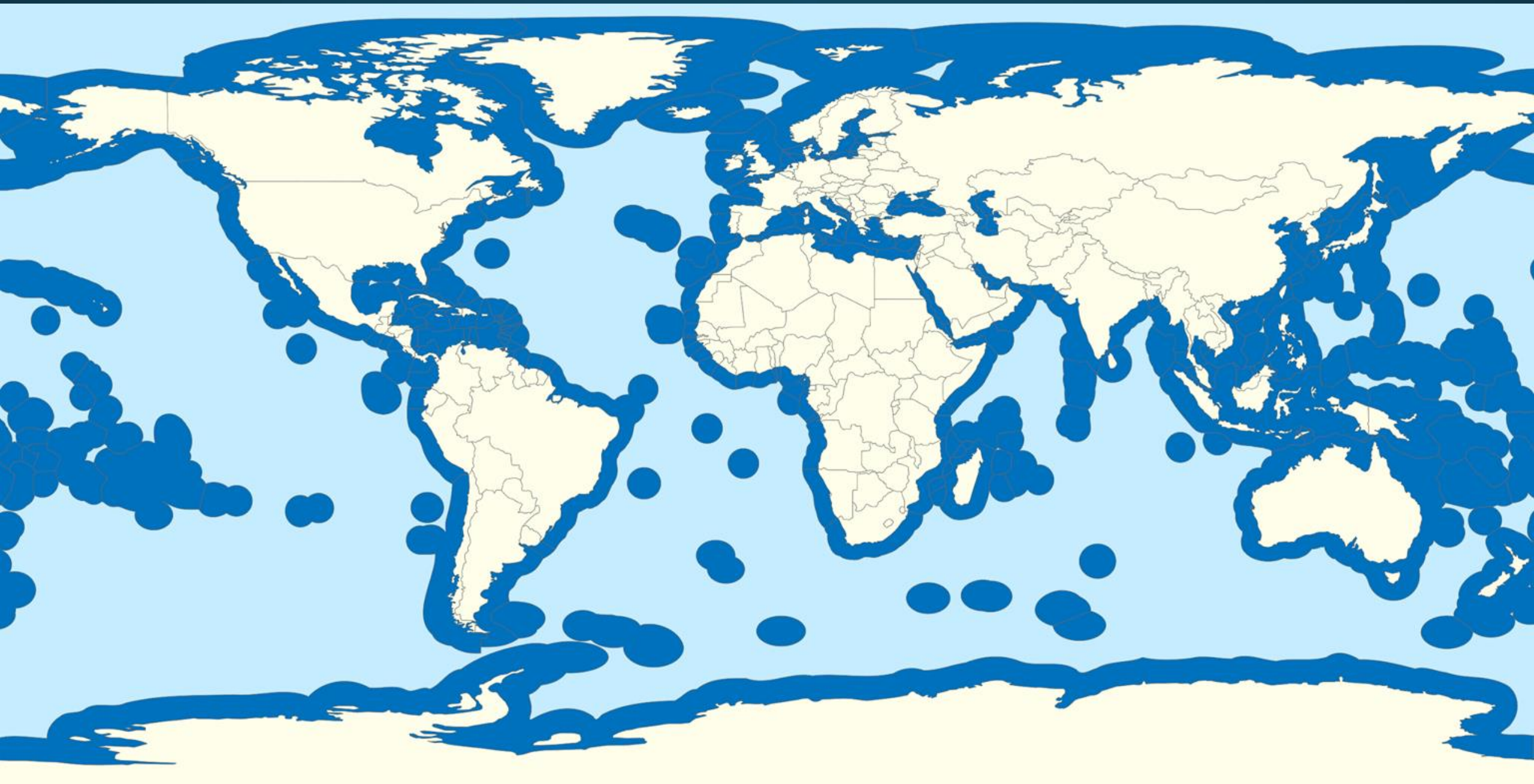
Crowdsourced bathymetry



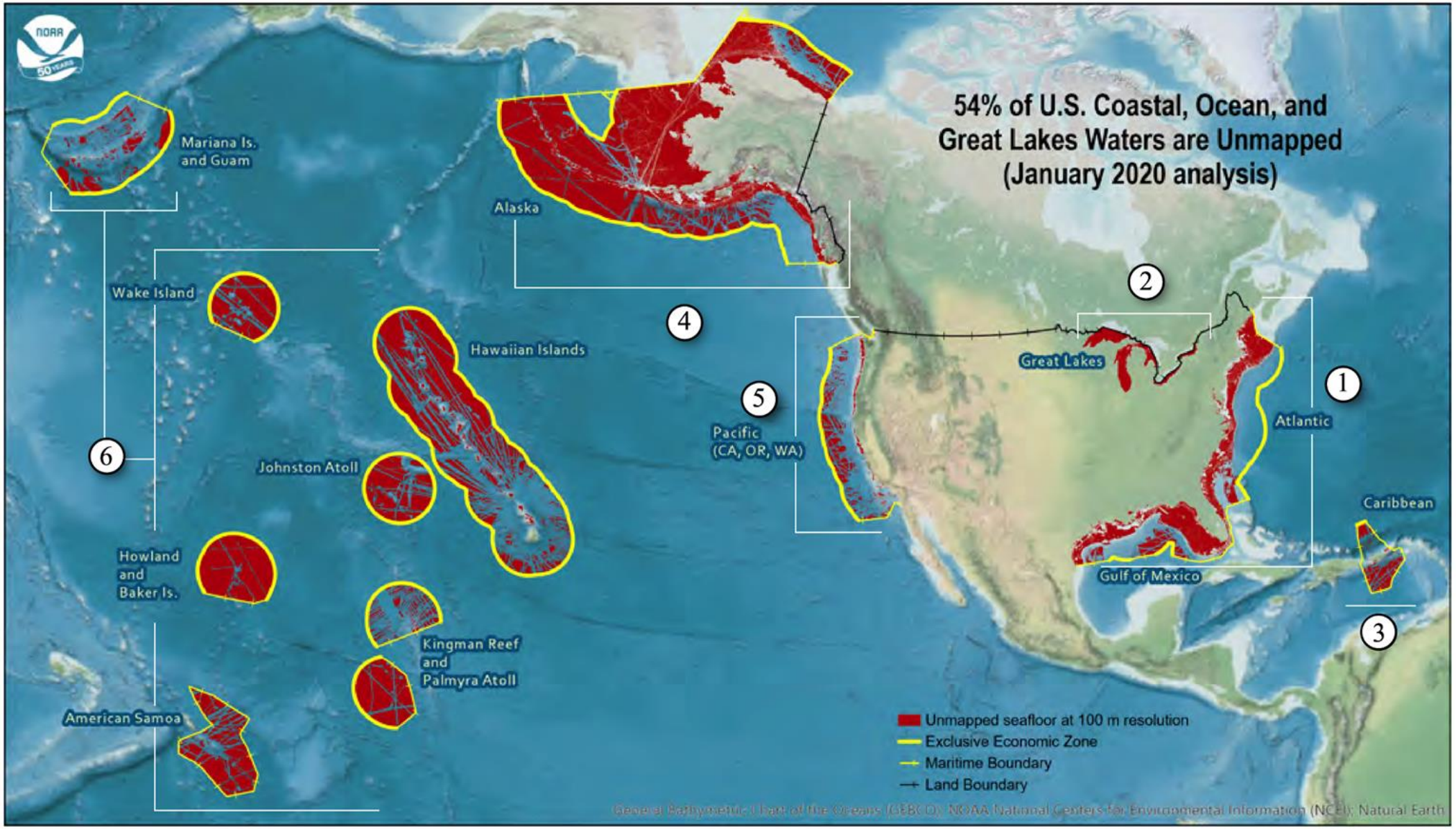
Difference in survey swath-width distance by depth.


CANADA
UNITED STATES
MÉXICO
VENEZUELA
COLOMBIA
PERÚ
BRAZIL
BOLIVIA
ARGENTINA
POLAND
GERMANY
UKRAINE
FRANCE
TURKEY
KAZAKHSTAN
MONGOLIA
CHINA
IRAN
ALGERIA
LIBYA
EGYPT
SAUDI ARABIA
INDIA
MYANMAR
MALI
NIGER
CHAD
SUDAN
NIGERIA
ETHIOPIA
DR CONGO
ANGOLA
ZAMBIA
AUSTRALIA


Tropic of Cancer
135°E
150°E
165°E
180°
165°W
150°W
135°W
Tropic of Cancer
Honolulu
HAWAII
Hawaiian Islands
THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS
Saipan
Agana
GUAM
15°N
15°N
PHILIPPINES
NORTH PACIFIC OCEAN
REPUBLIC OF THE MARSHALL ISLANDS
Koror
PALAU
FEDERATED STATES OF MICRONESIA
Pohnpei
Majuro
Northern Line Islands
Tarawa
Gilbert Islands
Equator
0°
NAURU
Yaren
KIRIBATI
Equator
0°
Phoenix Islands
KIRIBATI
KIRIBATI
Central Line Islands
PAPUA NEW GUINEA
Bismark Archipelago
INDONESIA
TUVALU
Funafuti
SOLOMON ISLANDS
Honiara
Santa Cruz Islands
TOKELAU
Marquesas Islands
Southern Line Islands
Port Moresby
Northern Group
WALLIS & FUTUNA
SAMOA
AMERICAN SAMOA
Pago Pago
Mata'Utu
Apia
15°S
15°S
Niue Group
COOK ISLANDS
Society Islands
Tuamotu Archipelago
VANUATU
Port Vila
FIJI
Yasawa Group
Suva
Papeete
NEW CALEDONIA
Loyalty Islands
Noumea
TONGA
Nuku'Alofa
Alofi
NIUE
Southern Group
Avarua
FRENCH POLYNESIA
Austral Islands
Gambier Islands
Tropic of Capricorn
Tropic of Capricorn
PITCAIRN ISLANDS
Adamstown
AUSTRALIA
Norfolk Island
30°S
30°S
Kermadec Islands
Lord Howe Island
SOUTH PACIFIC OCEAN
Canberra
Wellington
NEW ZEALAND
45°S
135°E
150°E
165°E
180°
165°W
150°W
135°W
45°S
Pacific Island Countries
(including EEZ's)
SINCLAIR KNIGHT MERZ



Source: Wikipedia



Percent of U.S. Waters Still Unmapped in 2019

U.S. waters

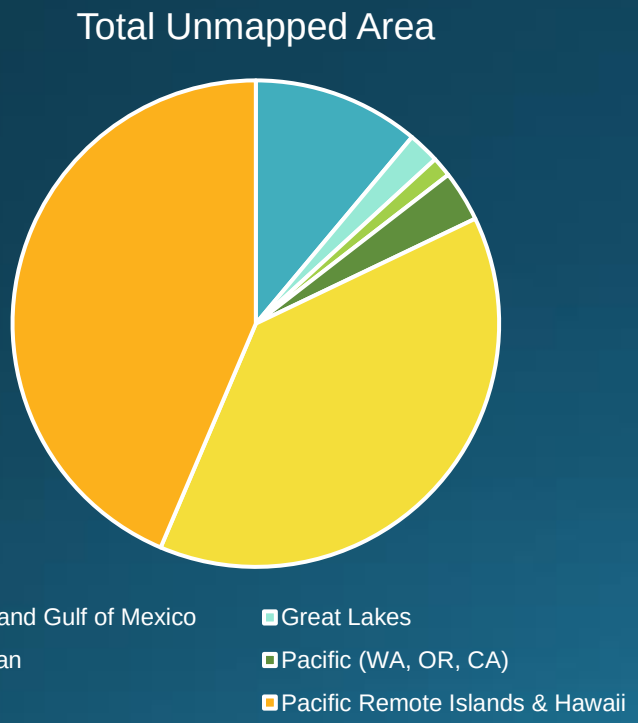
Total Area = 3,592,000 square nautical miles (snm)

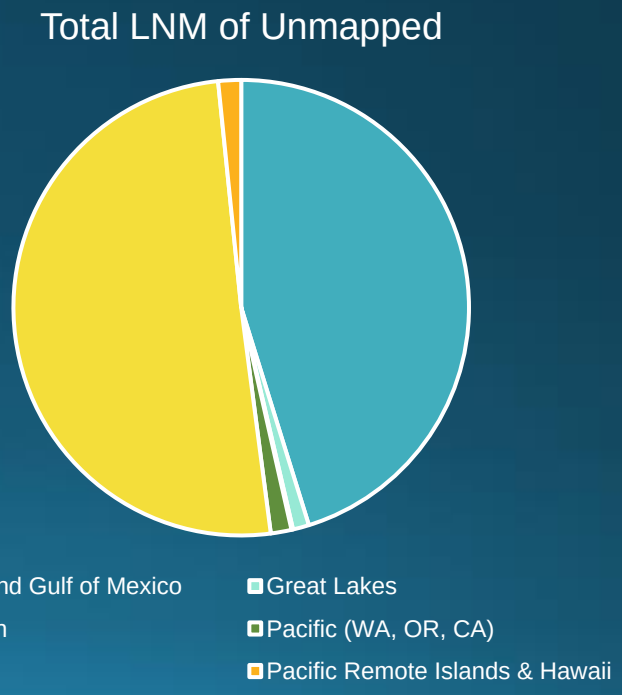
54%

57% - 2018

59% - 2017

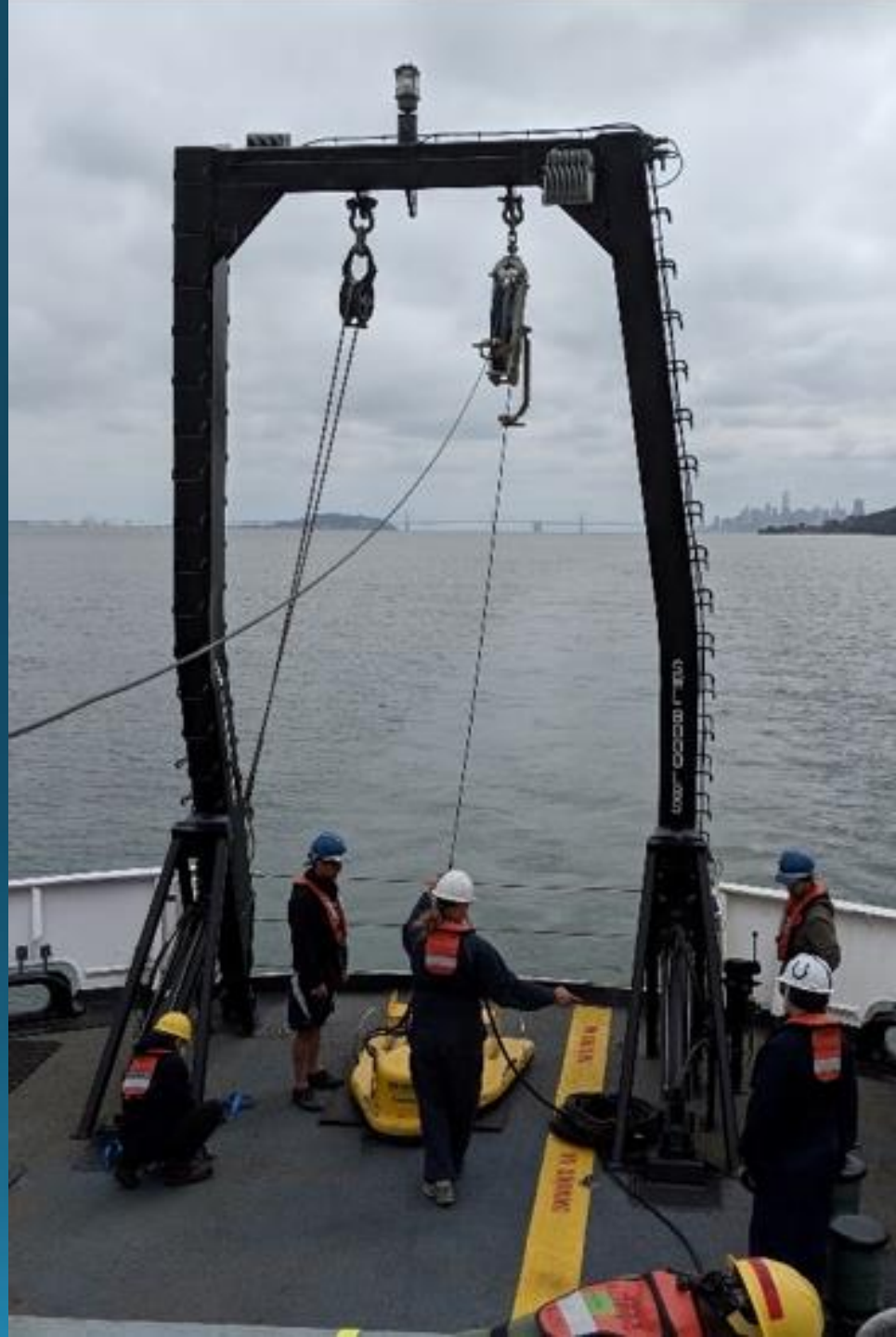
	Square Nautical Miles (Geodesic Area)						Linear Nautical Miles (Calculated)		
U.S. Waters by Region	Total Area	Total Unmapped Area	Percent of Unmapped Area	Total Shallow Water Area <1000m	Total Unmapped Deep Water Area >1000m	Total Unmapped Shallow Water Area <1000m	Total LNM of Unmapped	Total LNM of Unmapped >1000m	Total LNM of Unmapped <1000m
Atlantic and Gulf of Mexico	472,186	227,600	11%	282,859	32,793	194,807	8,145,822	51,427	8,094,395
Great Lakes	45,639	43,101	2%	45,639	0	43,101	206,912	427	206,485
Caribbean	61,540	27,254	1%	5,241	26,414	840	19,655	4,676	14,979
Pacific (WA, OR, CA)	239,705	69,317	3%	39,632	57,926	11,391	264,589	15,076	249,513
Alaska	1,080,238	789,900	38%	471,850	407,149	382,751	9,092,706	111,538	8,981,168
Pacific Remote Islands & Hawaii	1,691,726	894,585	44%	19,723	889,702	4,883	292,396	143,861	148,534
	3,591,032	2,051,757	1	864,944	1,413,984	637,773	18,022,081	327,006	17,695,075





So…How can we get this done?

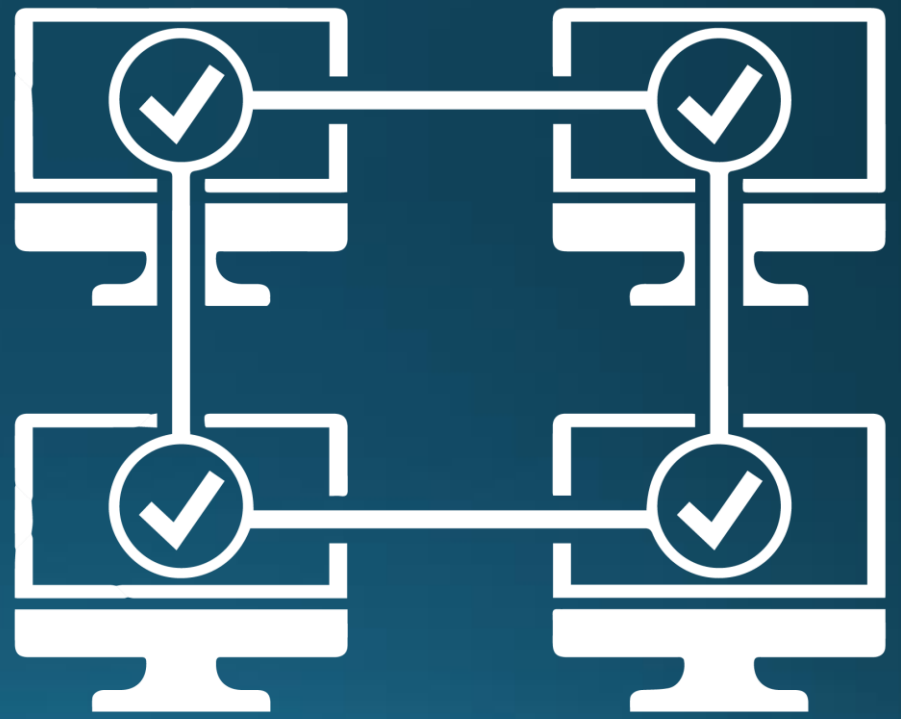
- Make use of as much existing data as possible.
- Coordinate standard protocols to ensure new data is suitable and available.
- Design mapping campaigns in the context of gap analysis
- Use existing mapping capacity (government/military, commercial, academic, and philanthropic fleets)
- Use emerging technology to drive efficiencies
- And, of course, find the money to pay for it. All money has strings.



Interagency Working Group on Ocean and Coastal Mapping Working to develop Standard Ocean Mapping Protocol

For broadly applicable mapping:

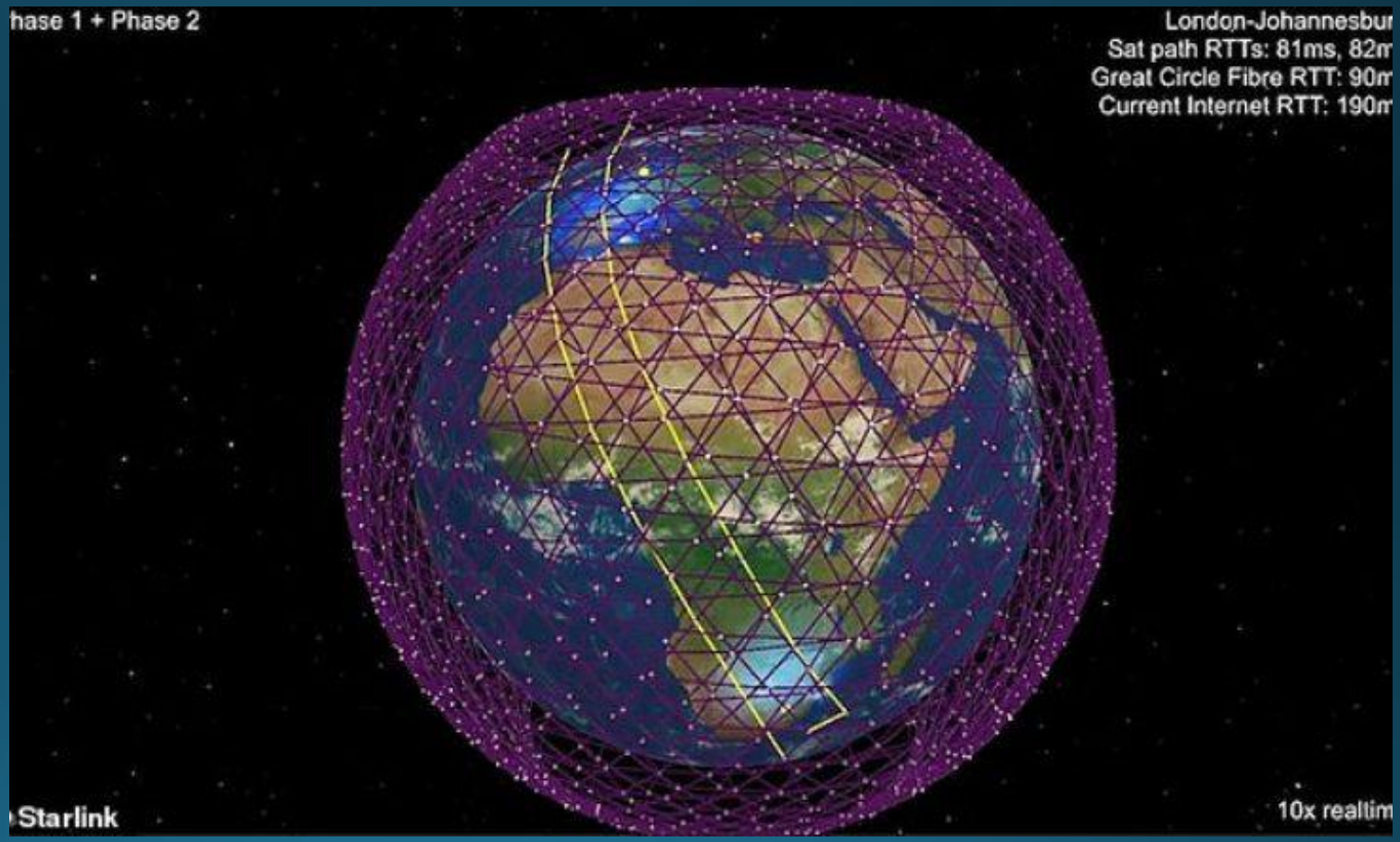
- Guide data acquisitions and processing
- Encourage widest access to data
- Minimize duplication
- Get data into public archives
- Use national data standards and best practices (GDA 2018)



Affordable, global, low latency, high bandwidth communications

Applications:

- Remote monitoring of autonomous survey vessels
- Remote operation of survey equipment on vessels
- Quality control and data availability in near real time
- NTRIP, Ocean Models, swarm operations



Starlink-built for the land, but has equal capacity over the oceans.

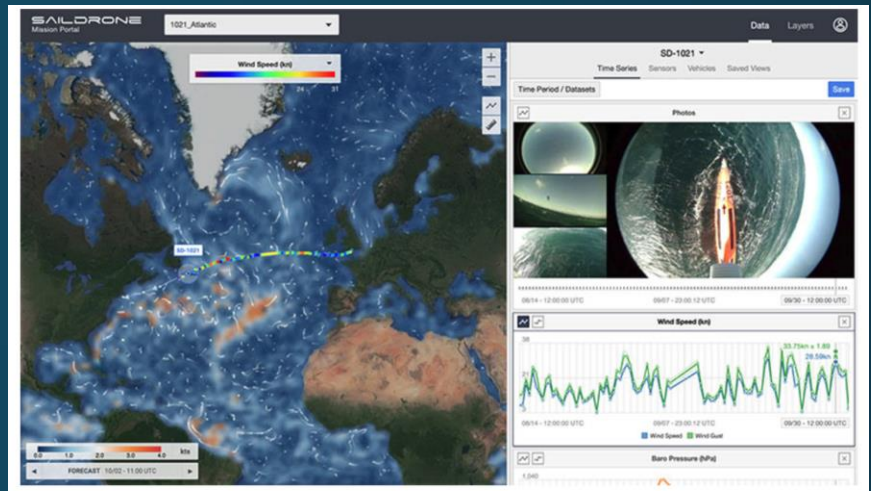

Xblue

Autonomous Vessels

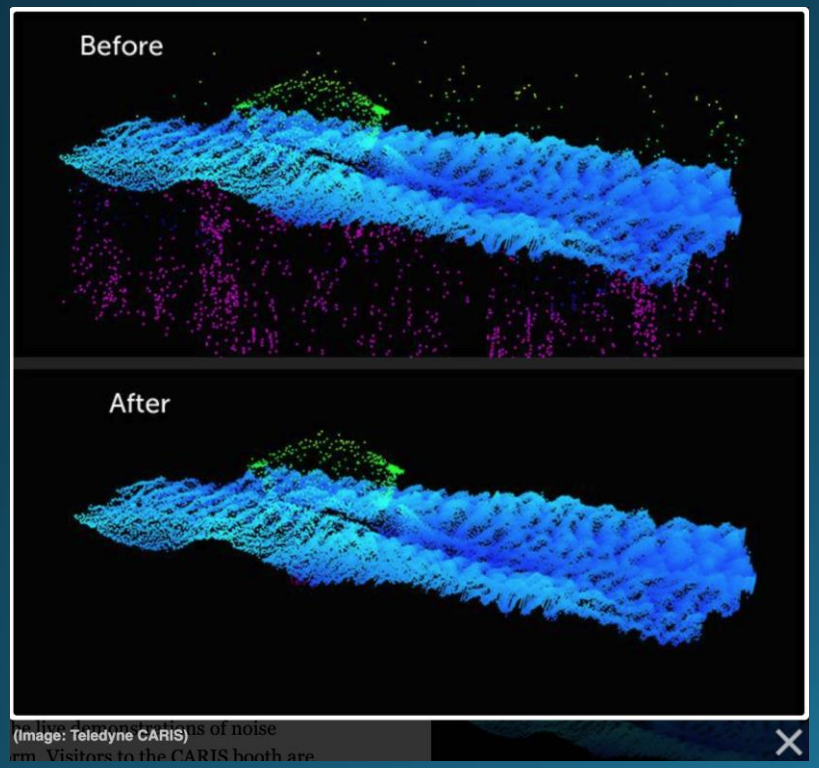
- Increase Autonomy
  - Mission aware
  - Reliable and Resilient
  - Reduce operator interaction
- Reduce cost
- Increase Range

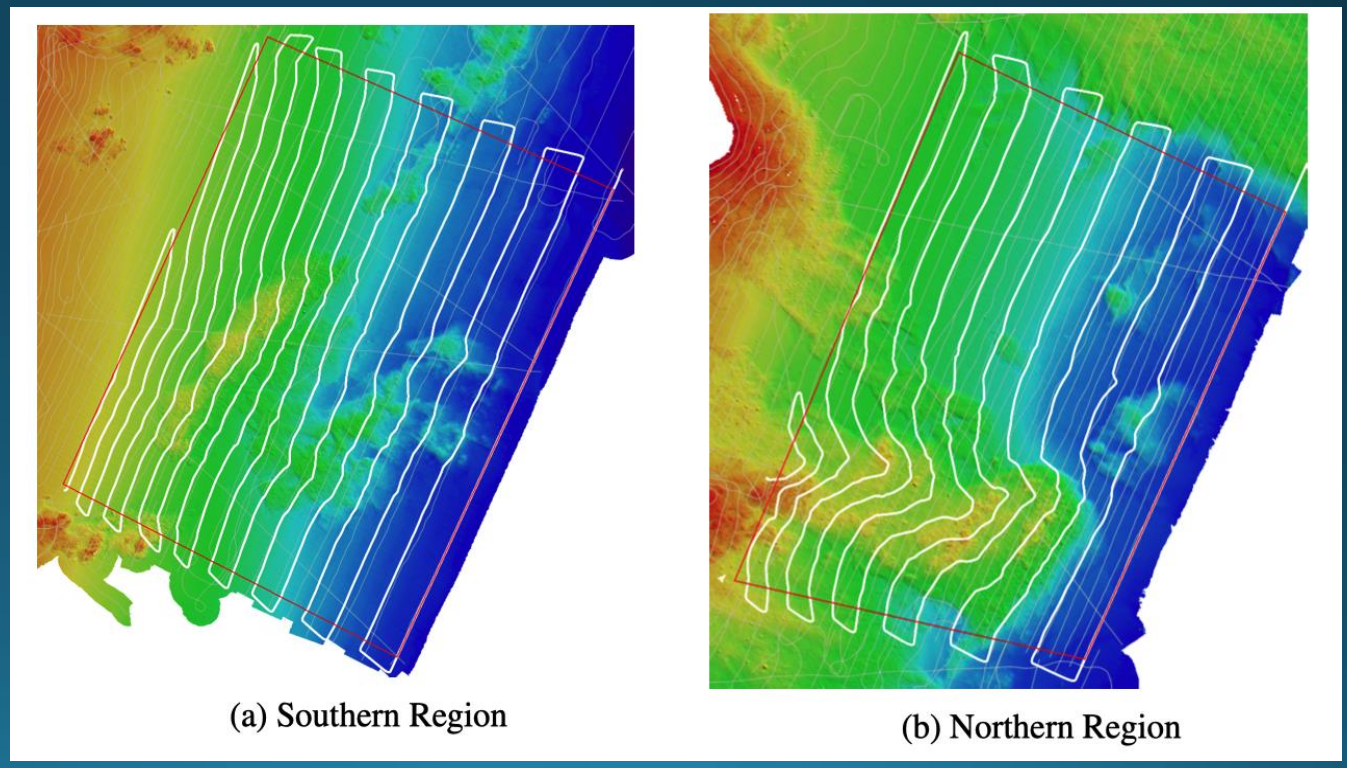
Artificial Intelligence

We simply cannot scale our current practices without smarter planning, monitoring, and processing algorithms



A look at the Saildrone Mission Portal showing the path of SD 1021's return trip across the Atlantic. The map shows predicted currents and the panel on the right shows images captured by the saildrone's onboard cameras and observed wind data.





(a) Southern Region

(b) Northern Region

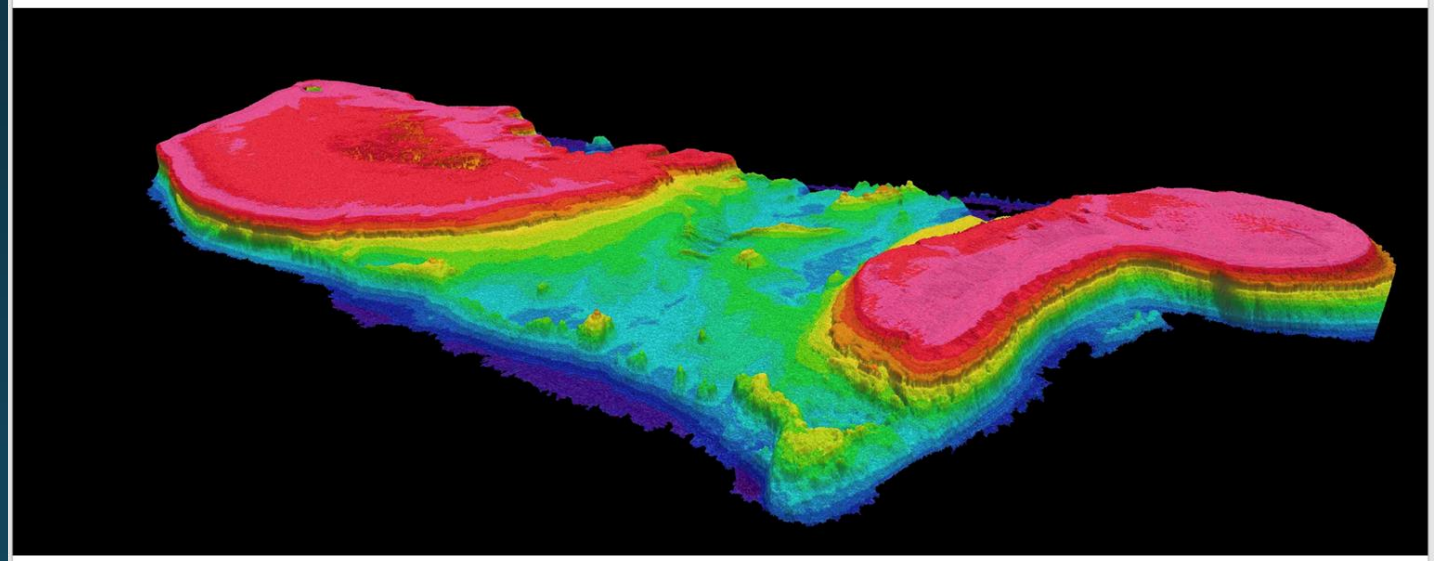
Bathymetric Lidar

- Less than 1% of the seafloor can be mapped with lidar.
- However, it is a critical tool for efficient mapping <40m where sonar work is much more difficult.
- Improvements in depth range, resolution, data processing, and seabed characterization are ongoing.

Satellite-derived Bathymetry

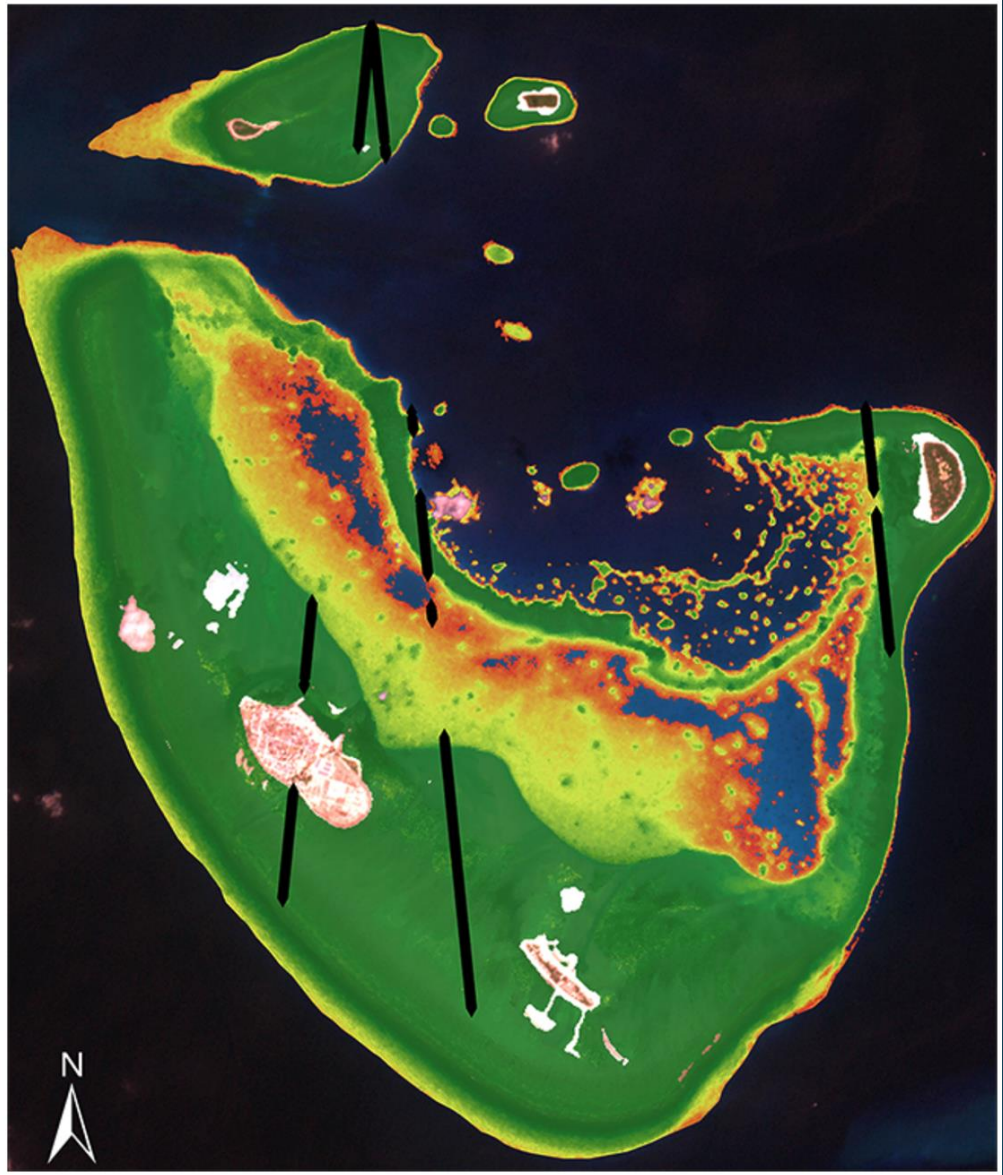
- Depth estimates from imagery
- Calibrated by relatively sparse ICE-SAT-2 altimetry

SDB @2m grid resolution

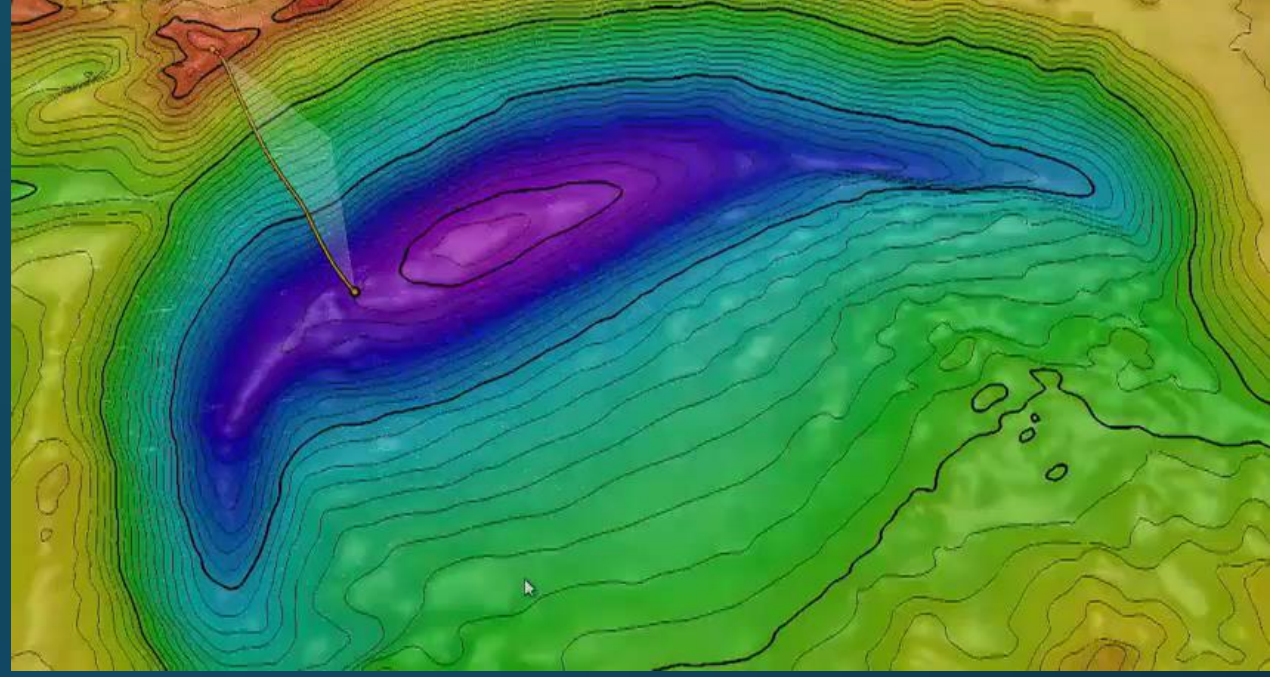


Heron and Sykes Reef, Great Barrier Reef

EOMAP



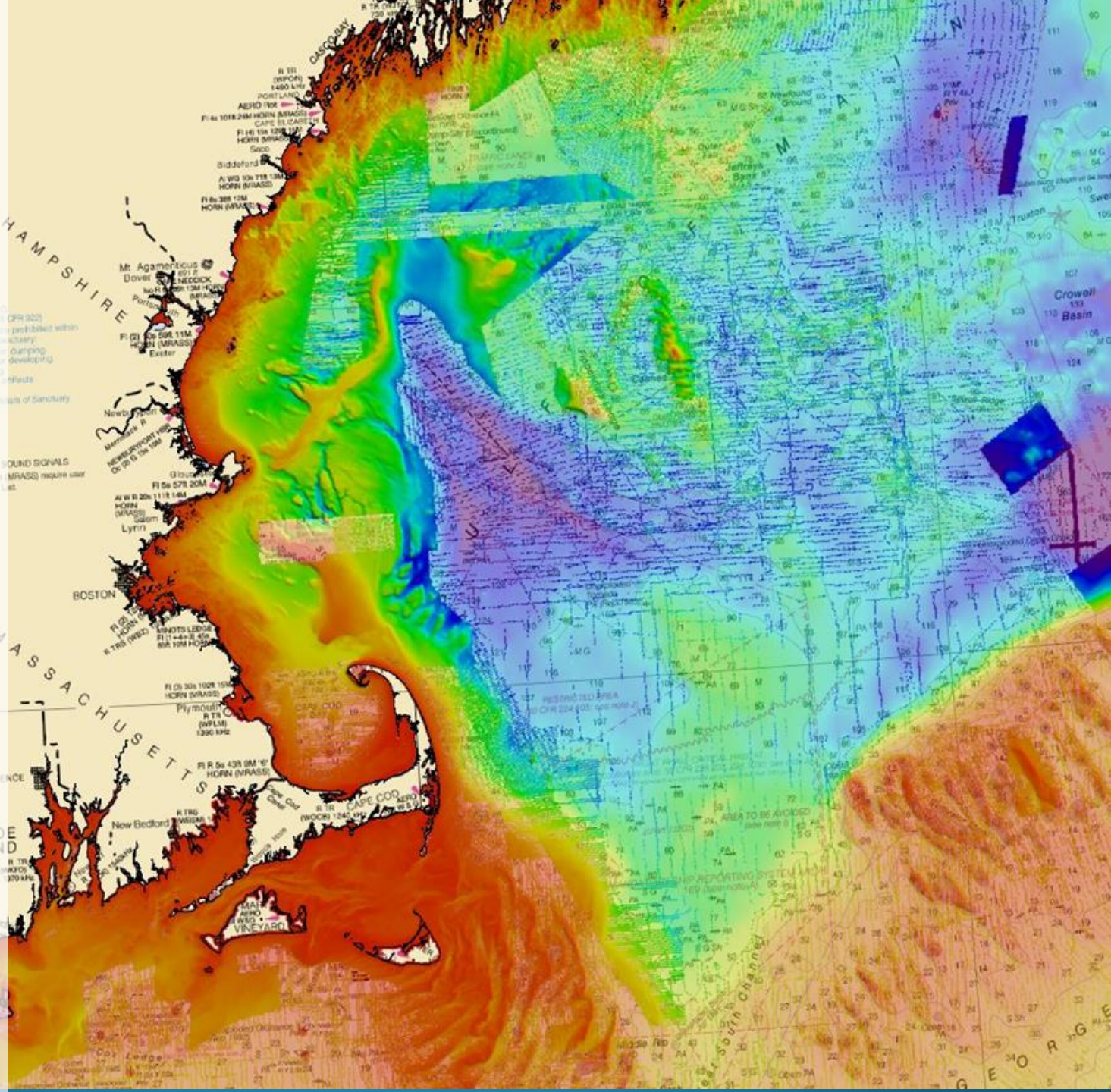
US: TCarta Marine, a global provider of marine geospatial products, is commercializing a new technique to derive highly accurate shallow-water bathymetry measurements from NASA's ICESat-2 satellite data. The new methodology is being developed by TCarta with funding from the National Science Foundation (NSF).



Pulling it all together:

The National Bathymetric Source

- Disparate data types, accuracy, and resolution collected over decades
- Sourced from archives, updated daily, compiled at source resolution
- Outputs vary for charting, modeling, visualization, and GIS analysis



Questions?

Thank you for attending!

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Interested in hosting a webinar and/or joining MTS?

Contact Monica Ostrander at Mostrander@mtsociety.org

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