The value of bathymetry
GEBCO and Seabed 2030

VAdm (ret.) Shin Tani

Chairman, Guiding Committee for GEBCO

on the occasion of ABLOS Seminar Qatar

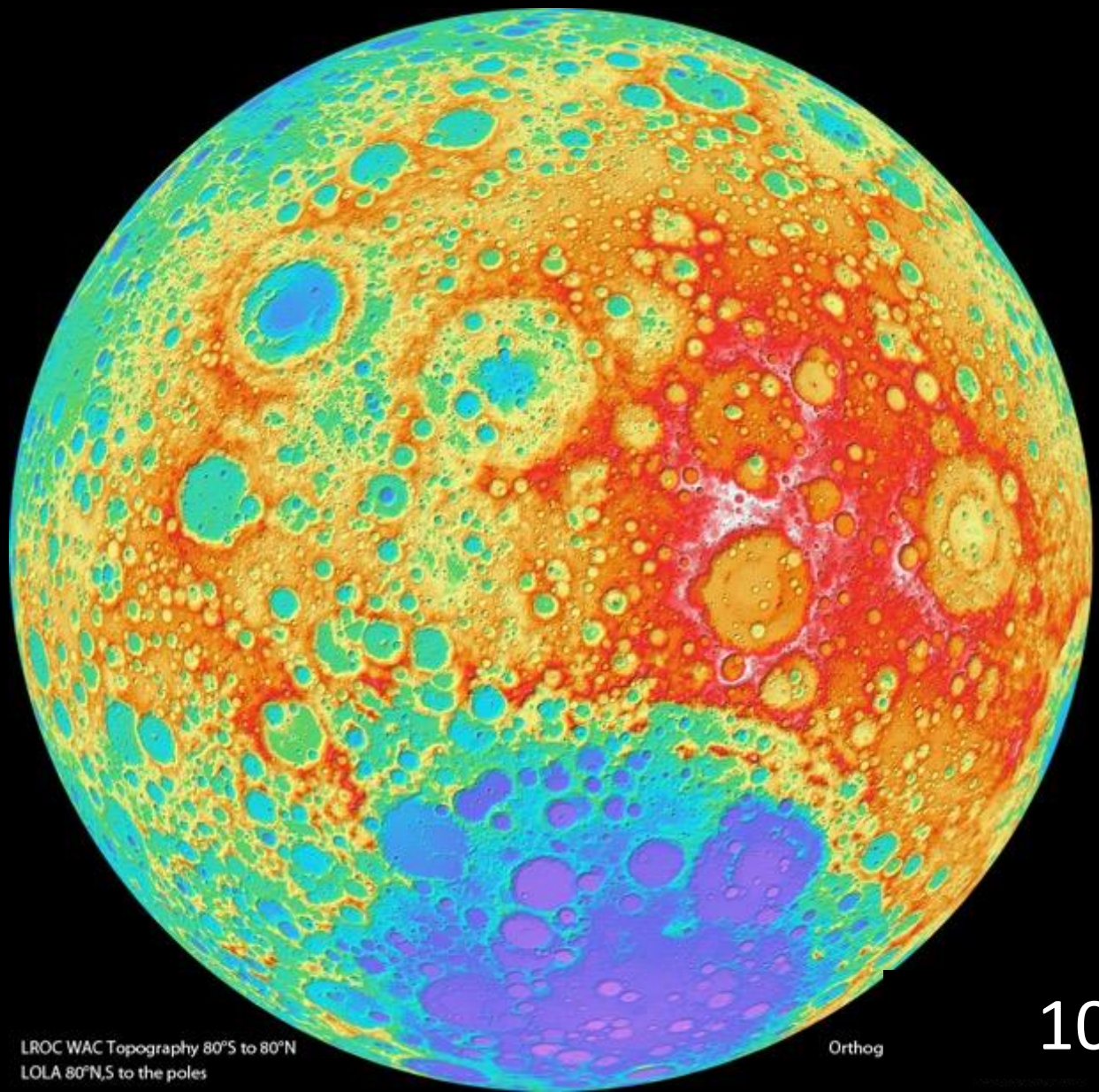
on 24th October 2018

at the Ritz-Carlton Doha, Qatar

Shin Tani

Geophysicist and Hydrographer	since 1978
ABLOS (Board Member)	since 2004
GEBCO Guiding Committee (Chair)	since 2013
Chair of ABLOS	2005-2008
National Hydrographer of Japan	2012-2014
Cabinet Counsellor in charge of Extended Continental Shelf	2003-2012
Head of Geodetic System Transformation	2000-2002

Moon



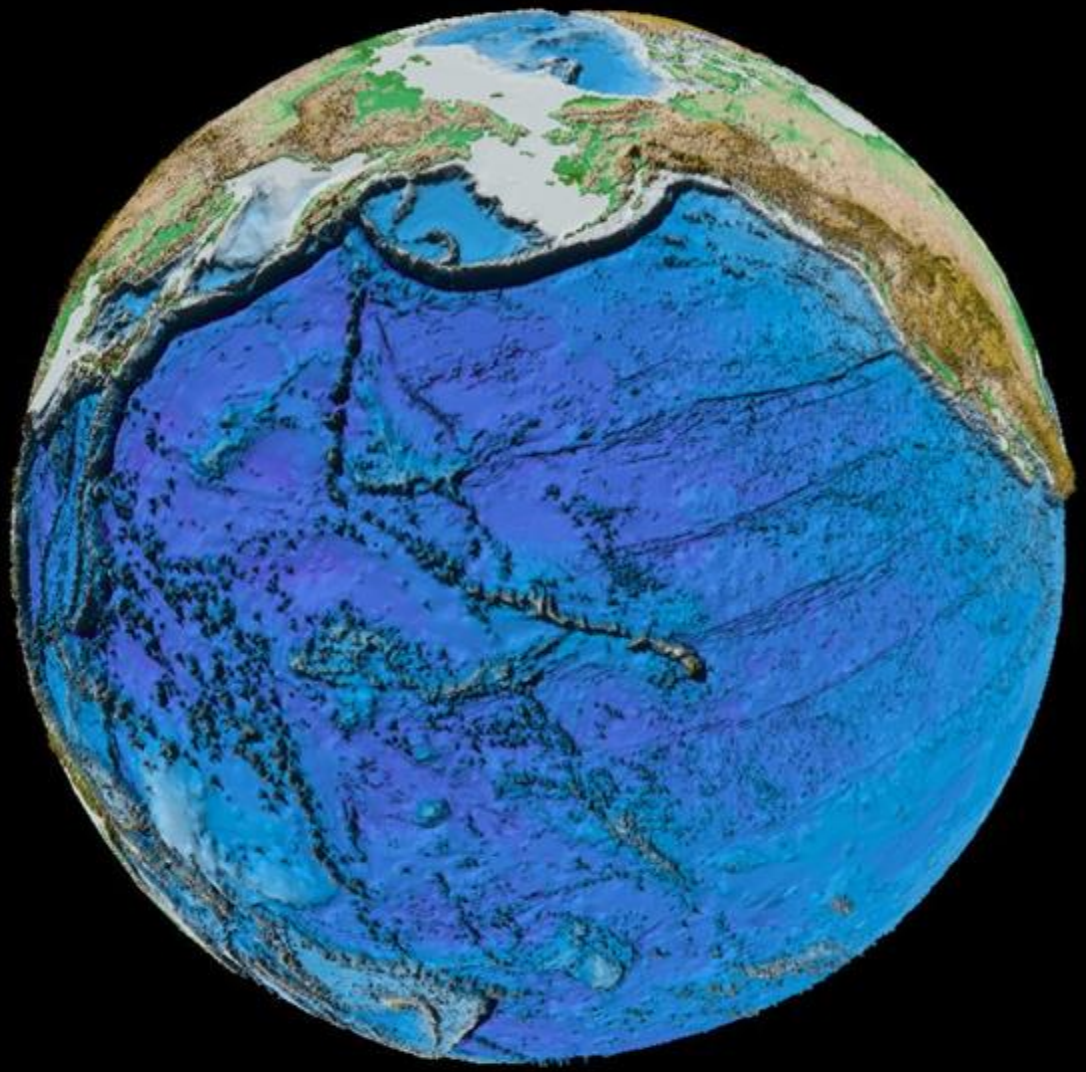
100m grid

Mars

火星の地形

1m grid

and…. how about our mother Earth?



1km grid

GEBCO

What is GEBCO ?

The General Bathymetric Chart of the Oceans (GEBCO):

- is project to create and maintain the most authoritative bathymetric data and charts, as well as gazetteer of sea bottom features.
- is promoted by the International Hydrographic Organization (IHO) And Intergovernmental Oceanographic Commission (IOC) of UNESCO.
- provides GEBCO products to public for free of charge;
  - 30 arcsecond grid of the global bathymetry
    GEBCO 2014
  - World map created using GEBCO2014
    GEBCO World Map 2014
  - Gazetteer of sea bottom features
    GEBCO Gazetteer

The history of GEBCO

The General Bathymetric Chart of the Oceans (GEBCO):

- was initiated by HSH Prince Albert I in 1903.
- Monaco Government, then the International Hydrographic Bureau (IHB) promoted GEBCO after the Prince passed away.
- UNESCO-IOC joined in 1973.

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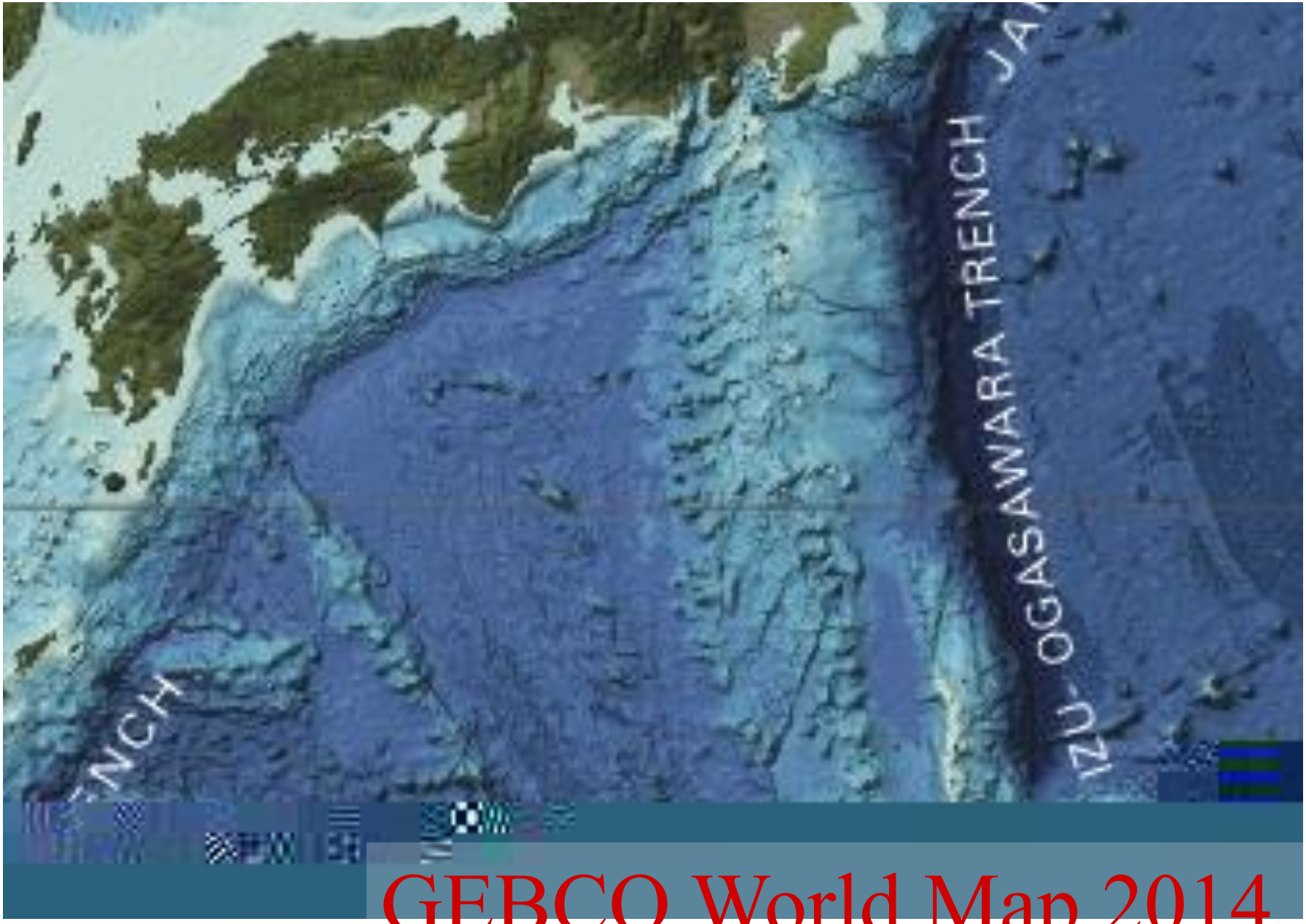
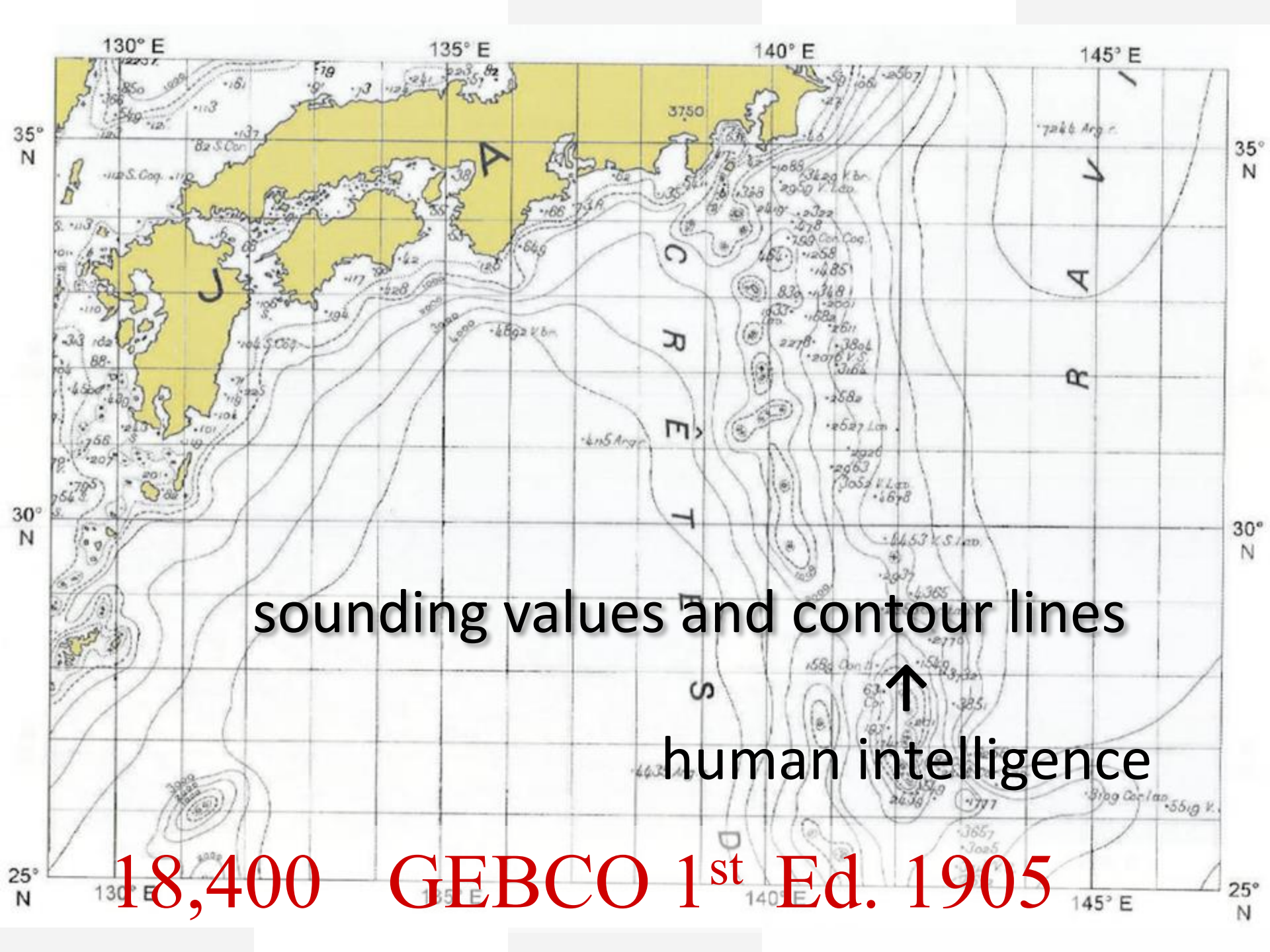
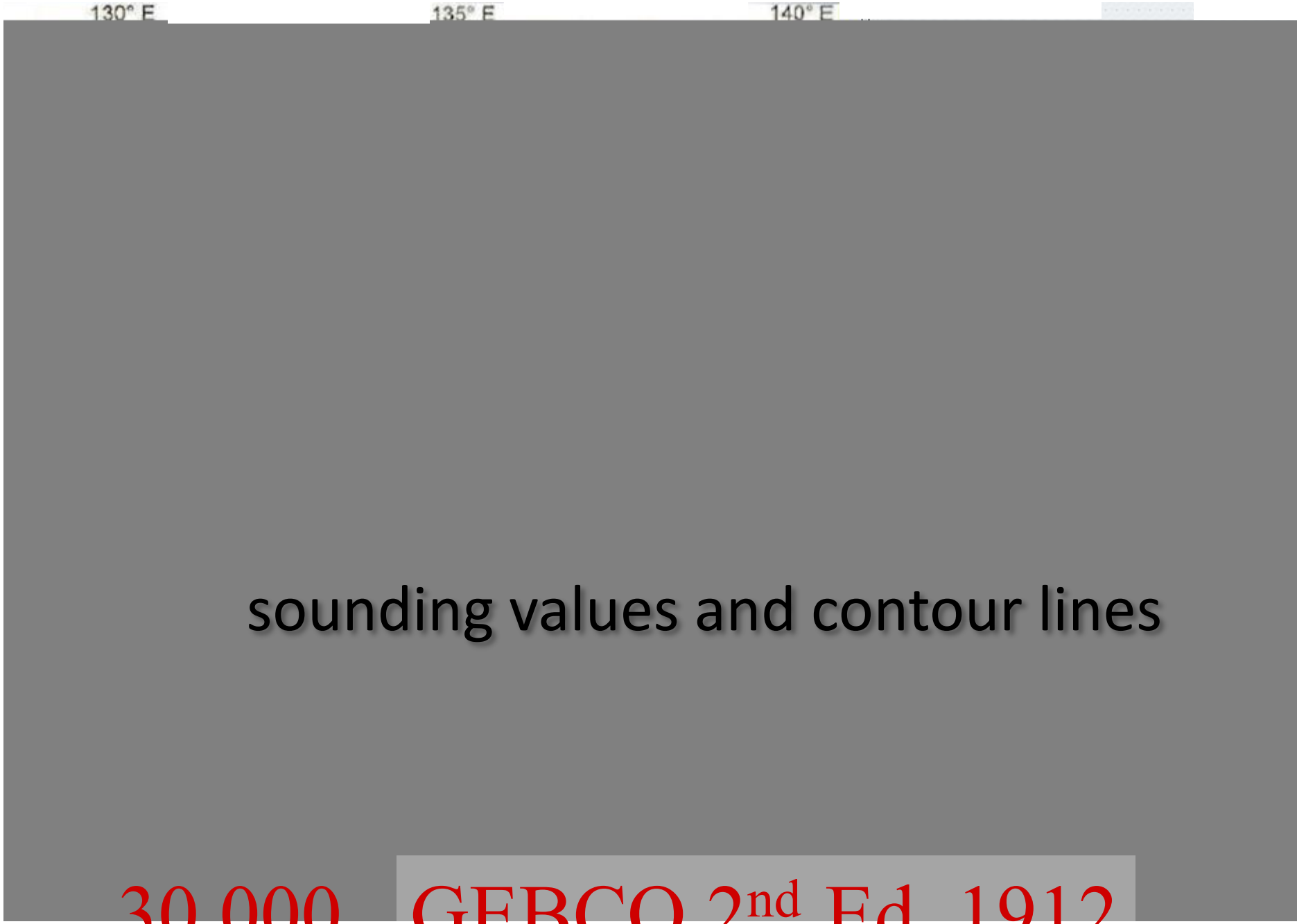


GEBCO World Map 2014


130° E
135° E
140° E
145° E
35° N
30° N
25° N
JAPAN
CRETE
PHILIPPINE SEA
3750
sounding values and contour lines
↑
human intelligence
18,400 GEBCO 1st Ed. 1905

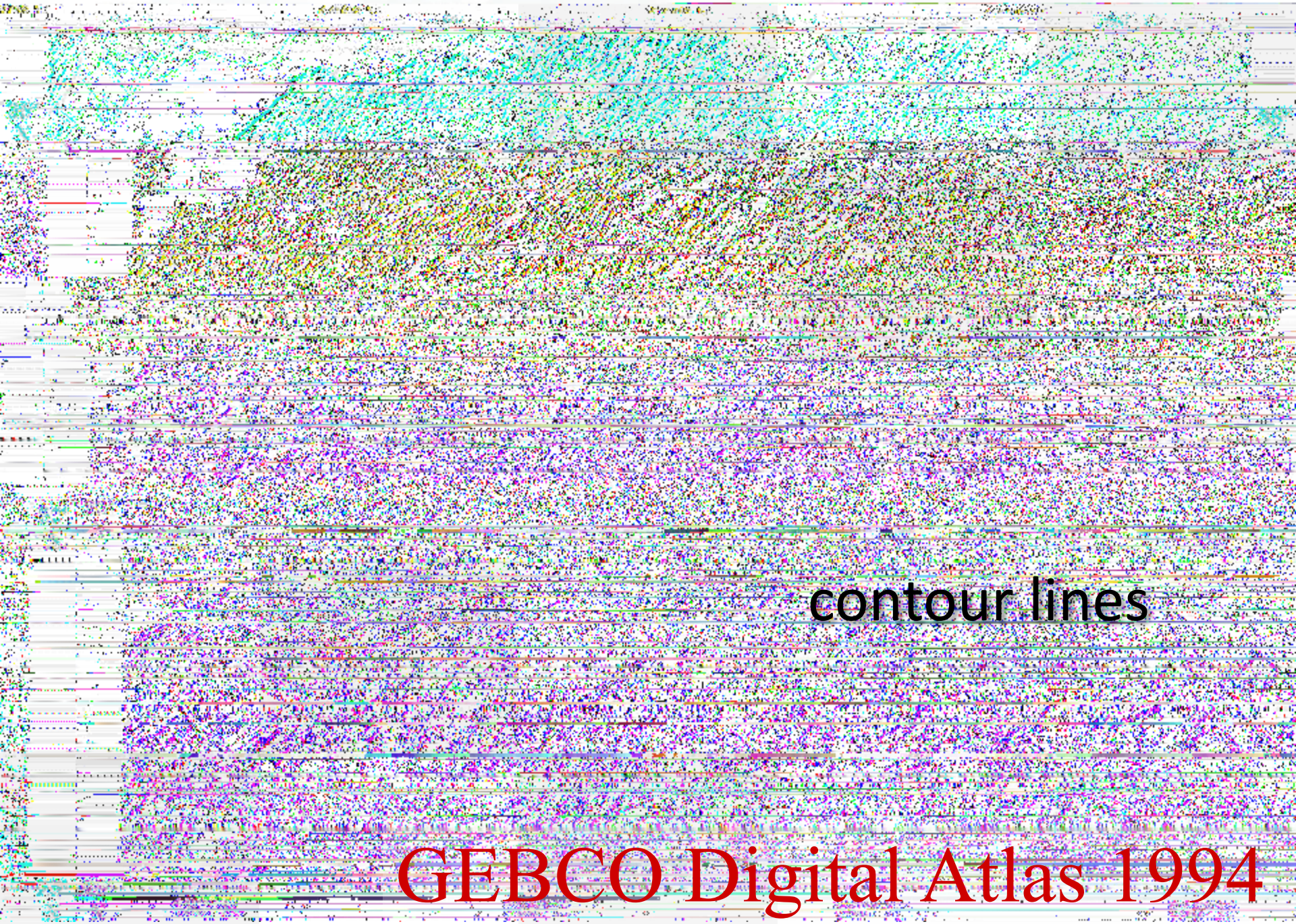

130° E
135° E
140° E
sounding values and contour lines
30,000
GEBCO 2nd Ed. 1912

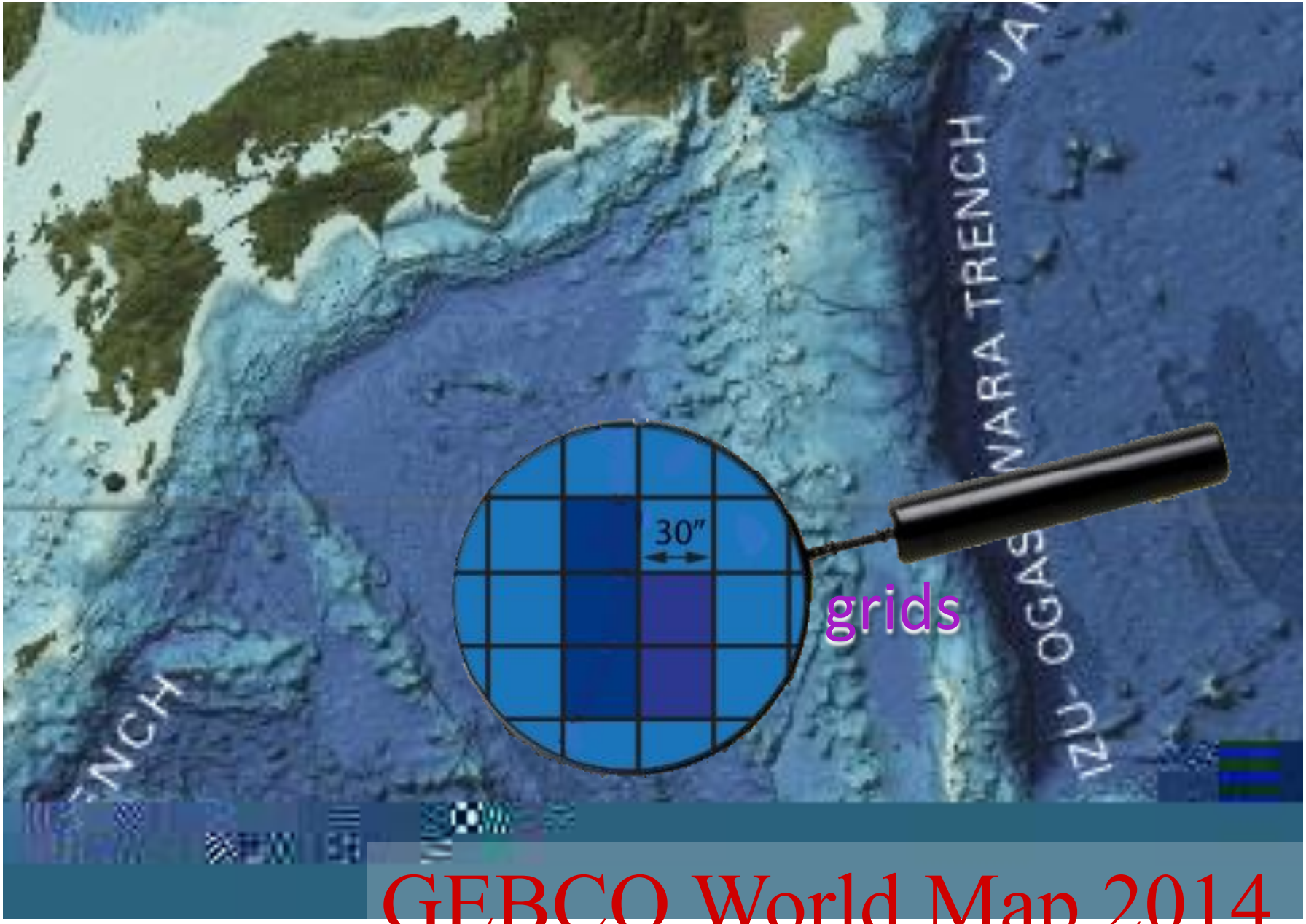
sounding values and contour lines

358,700 GEBCO 3rd Ed. 1940

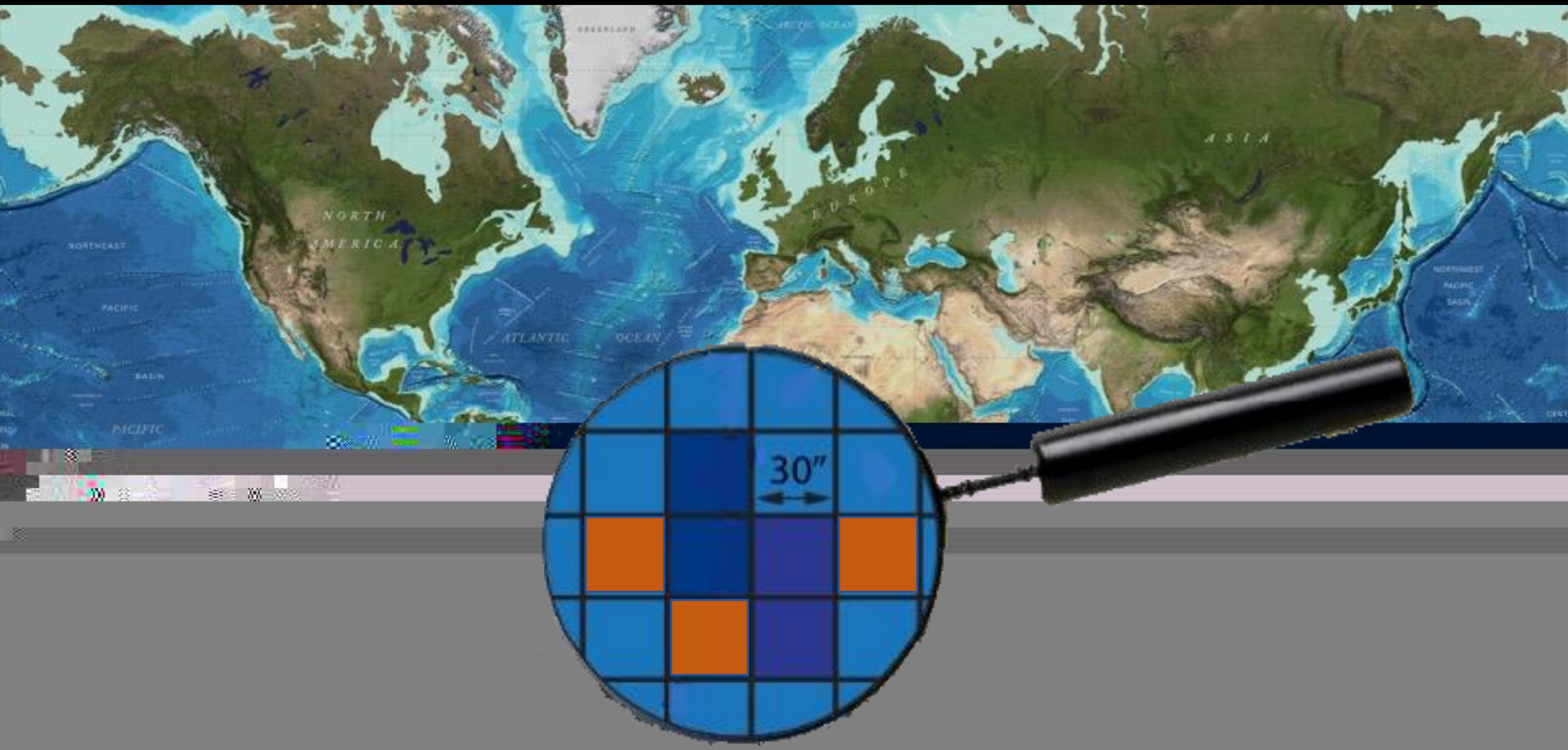
contour lines

GEBCO 5th Ed. 1979


contour lines
GEBCO Digital Atlas 1994

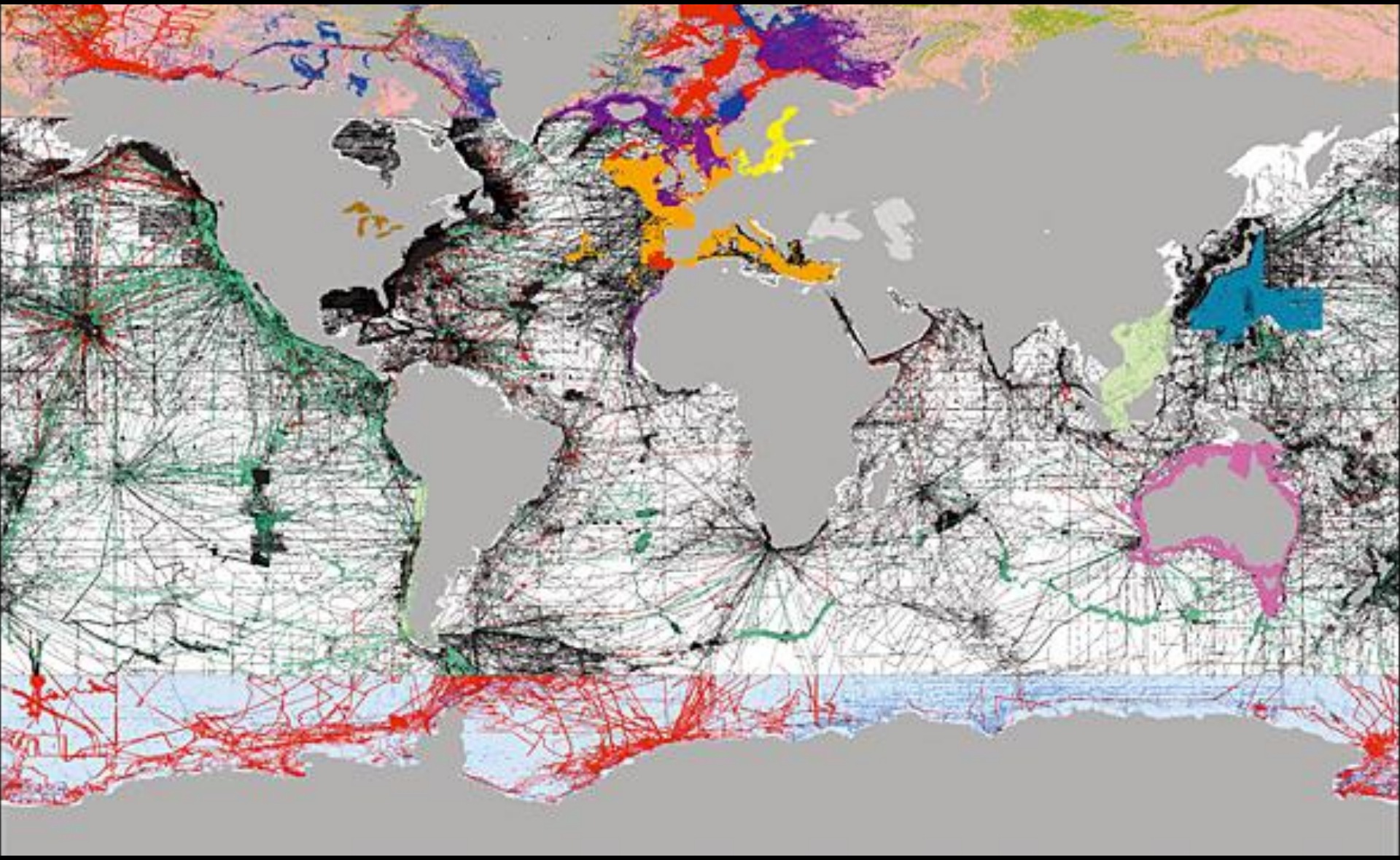


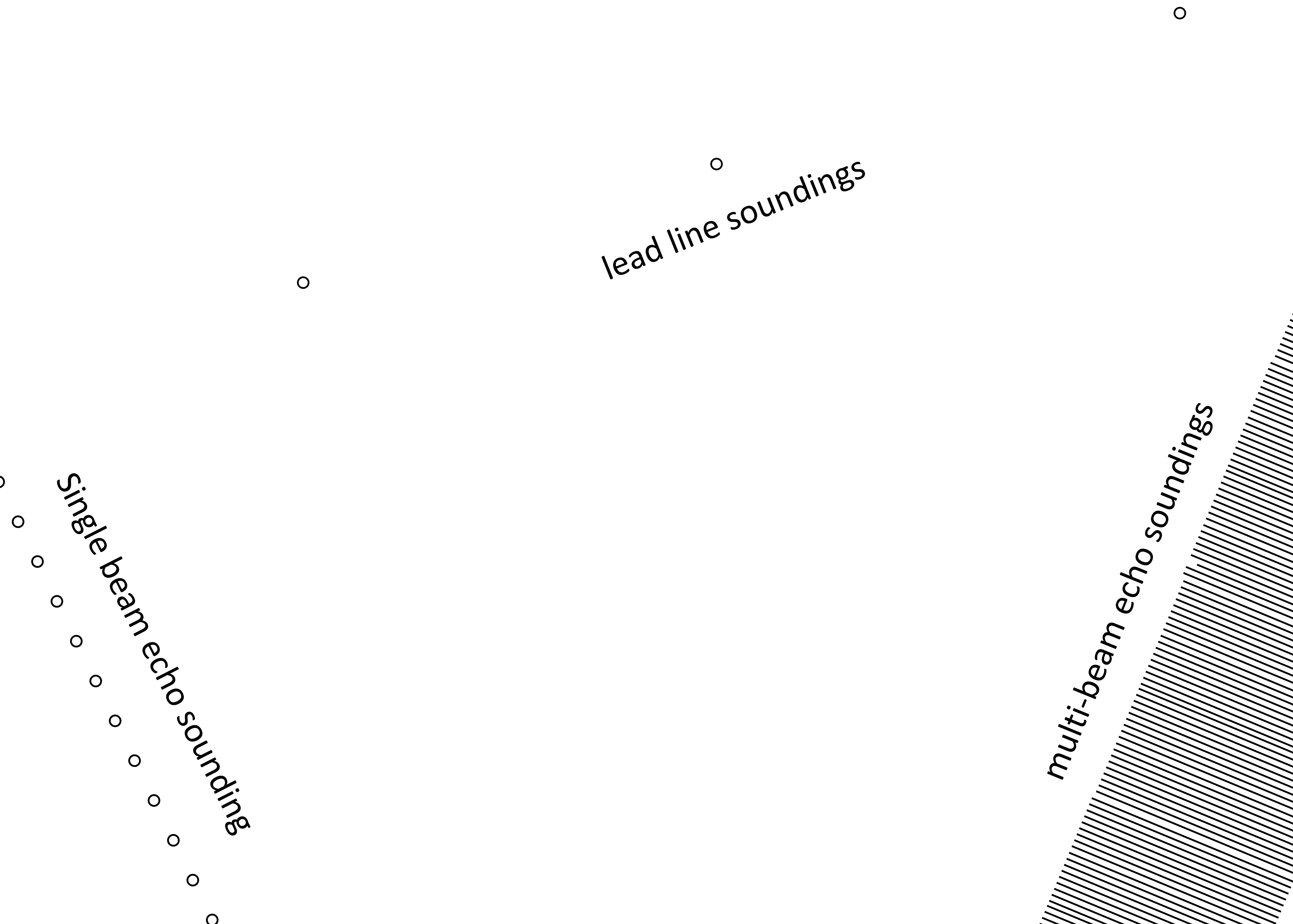
GEBCO World Map 2014

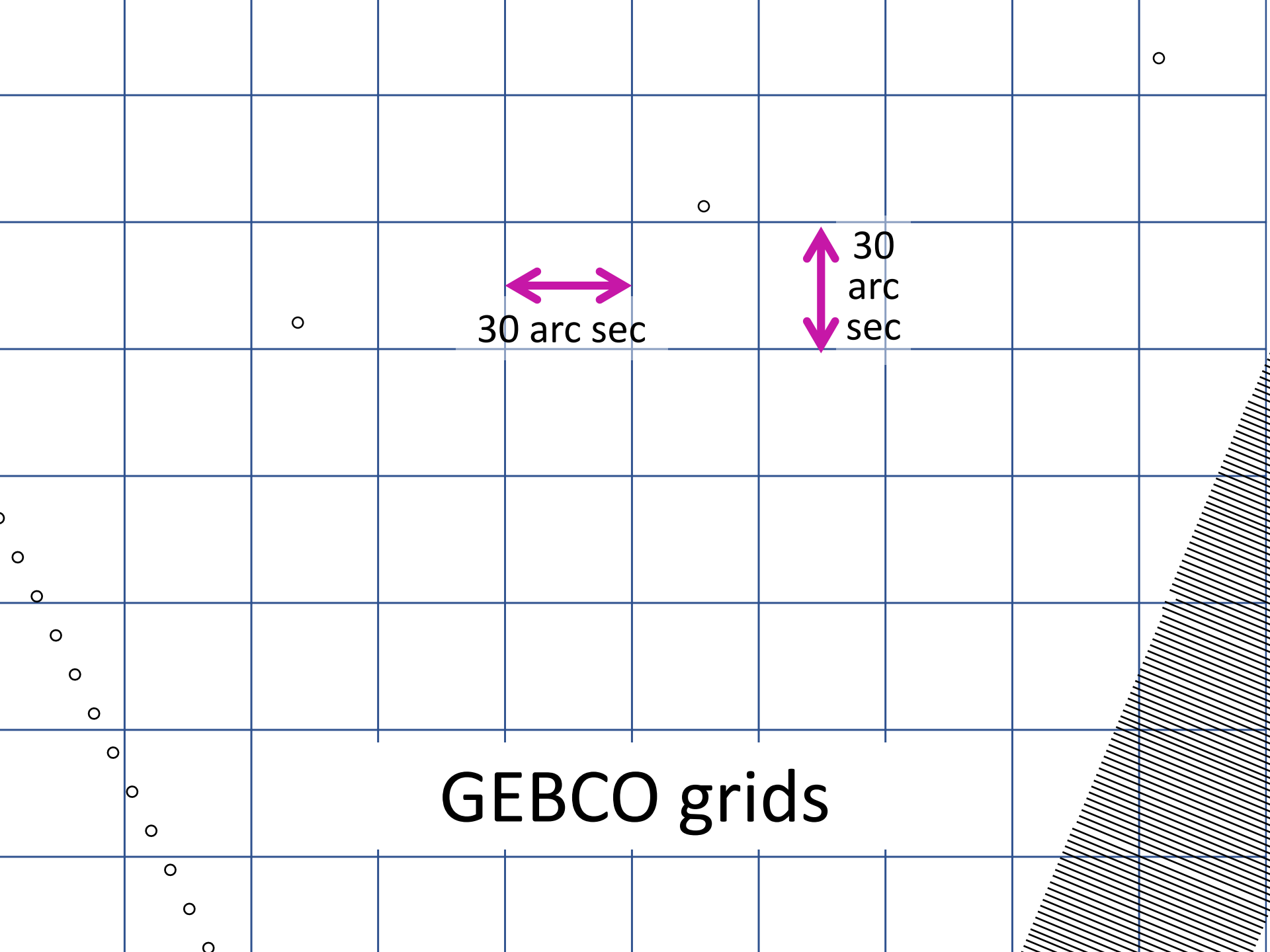


Ocean grids are 616 million.

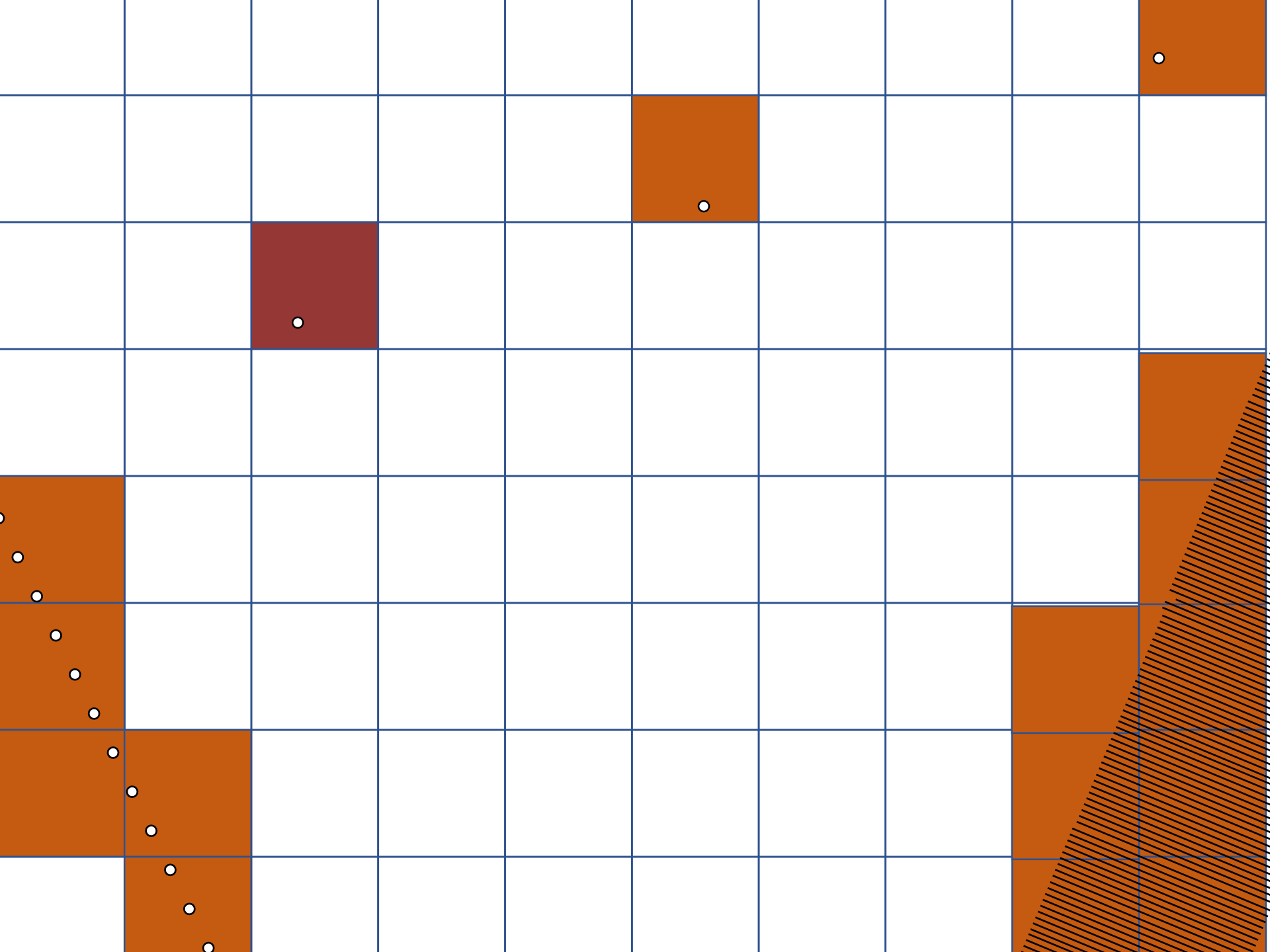
However only 18% of the grids have real soundings.

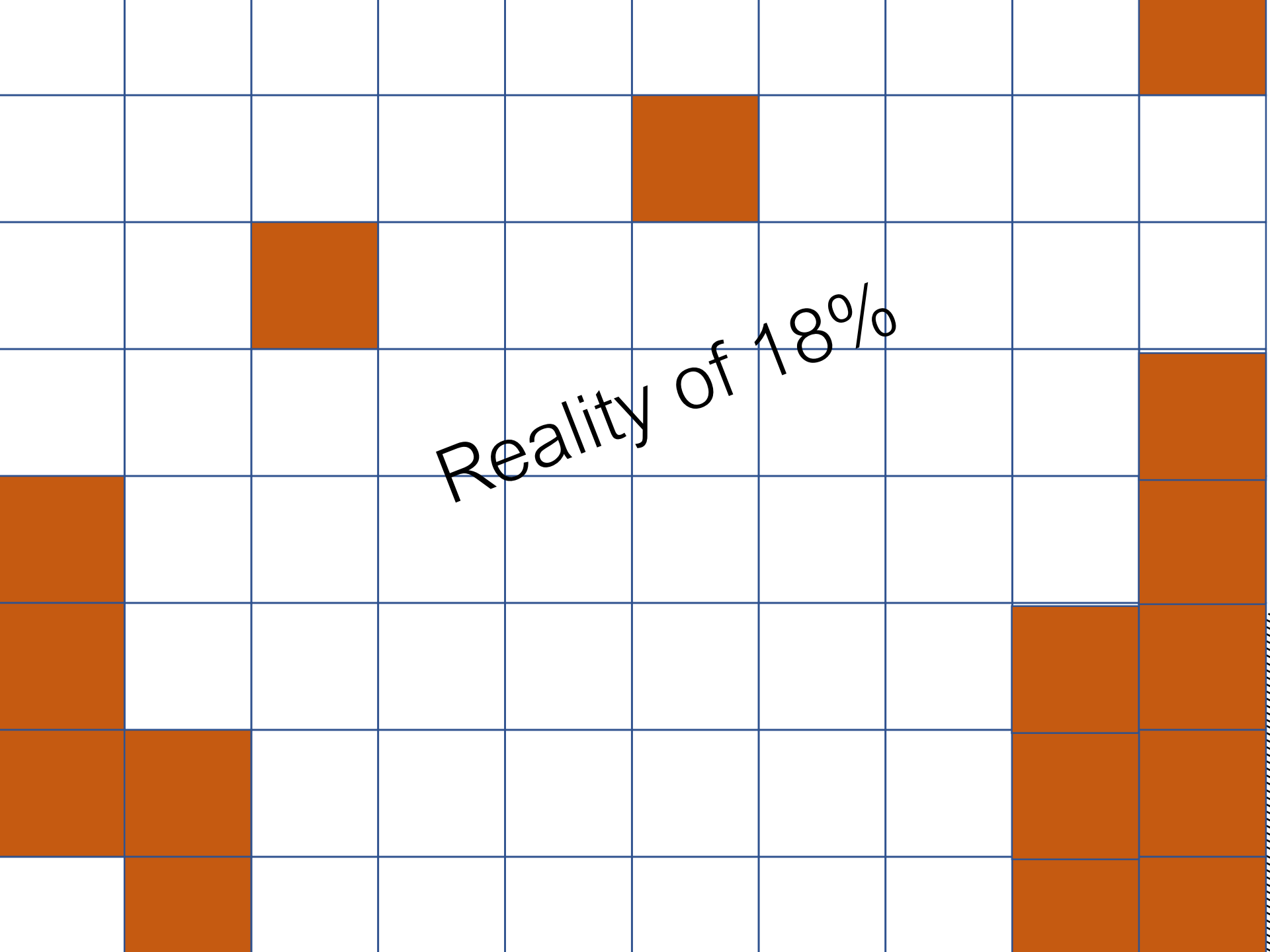


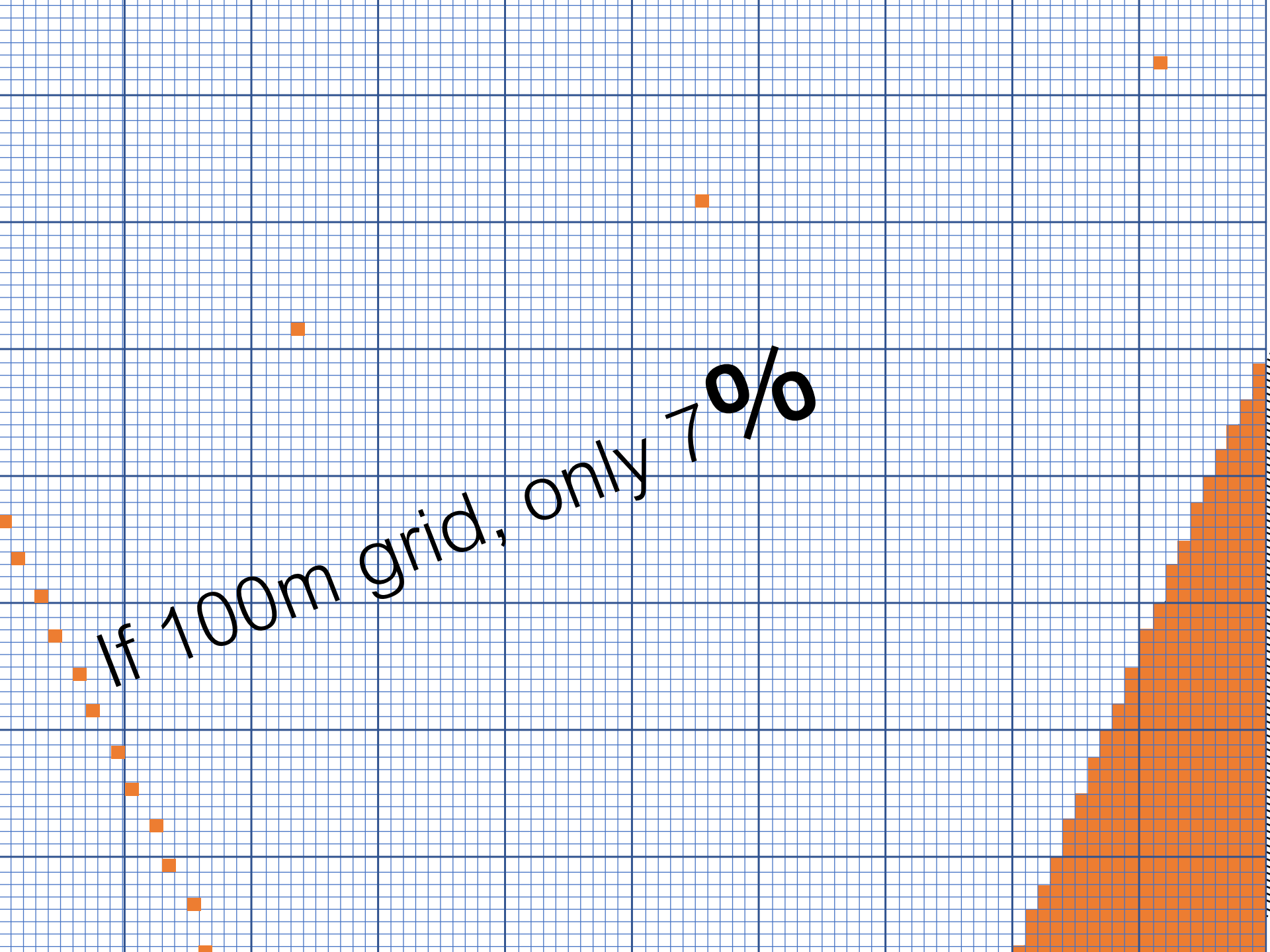

lead line soundings
Single beam echo sounding
multi-beam echo soundings

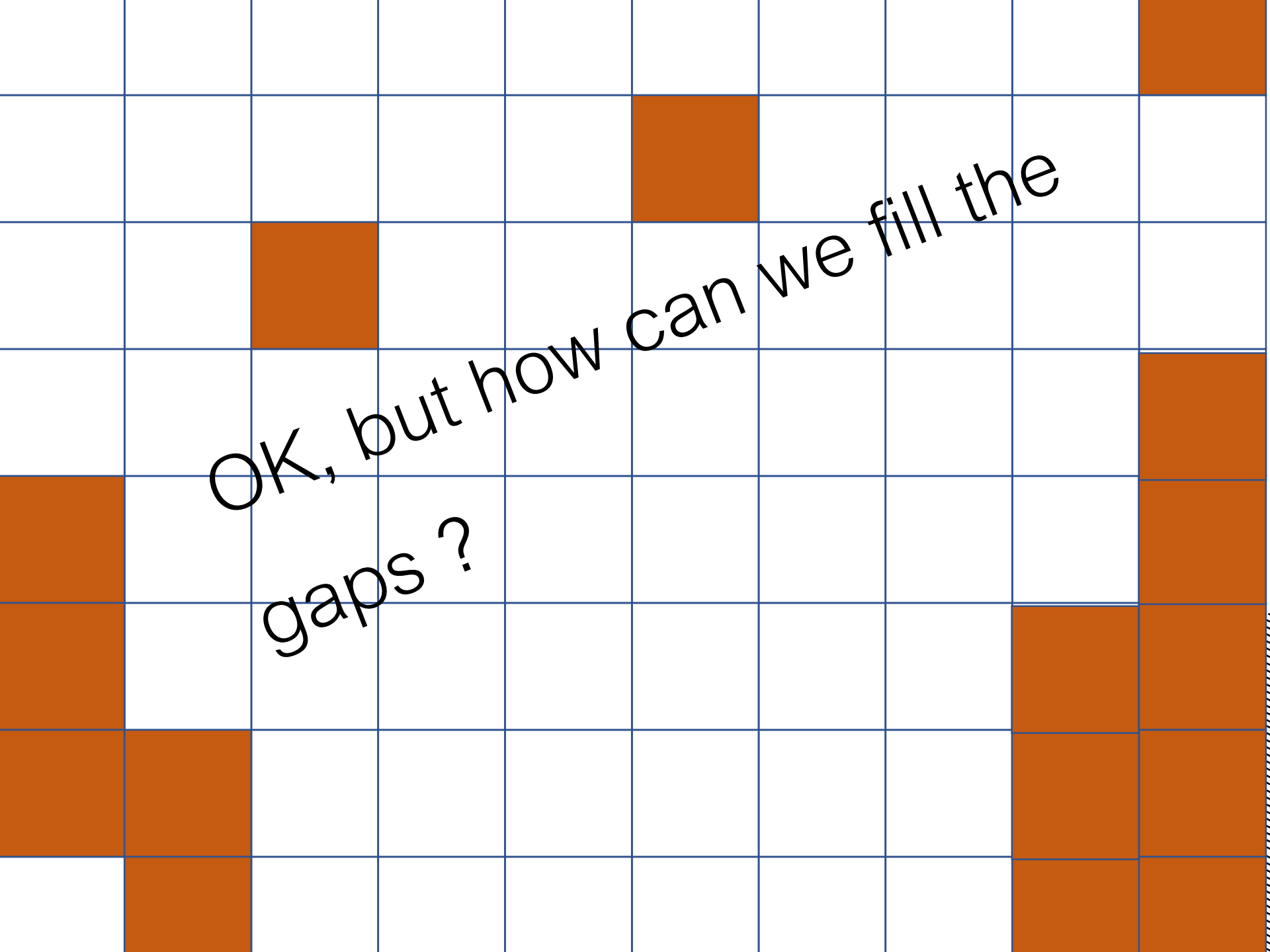


GEBCO grids



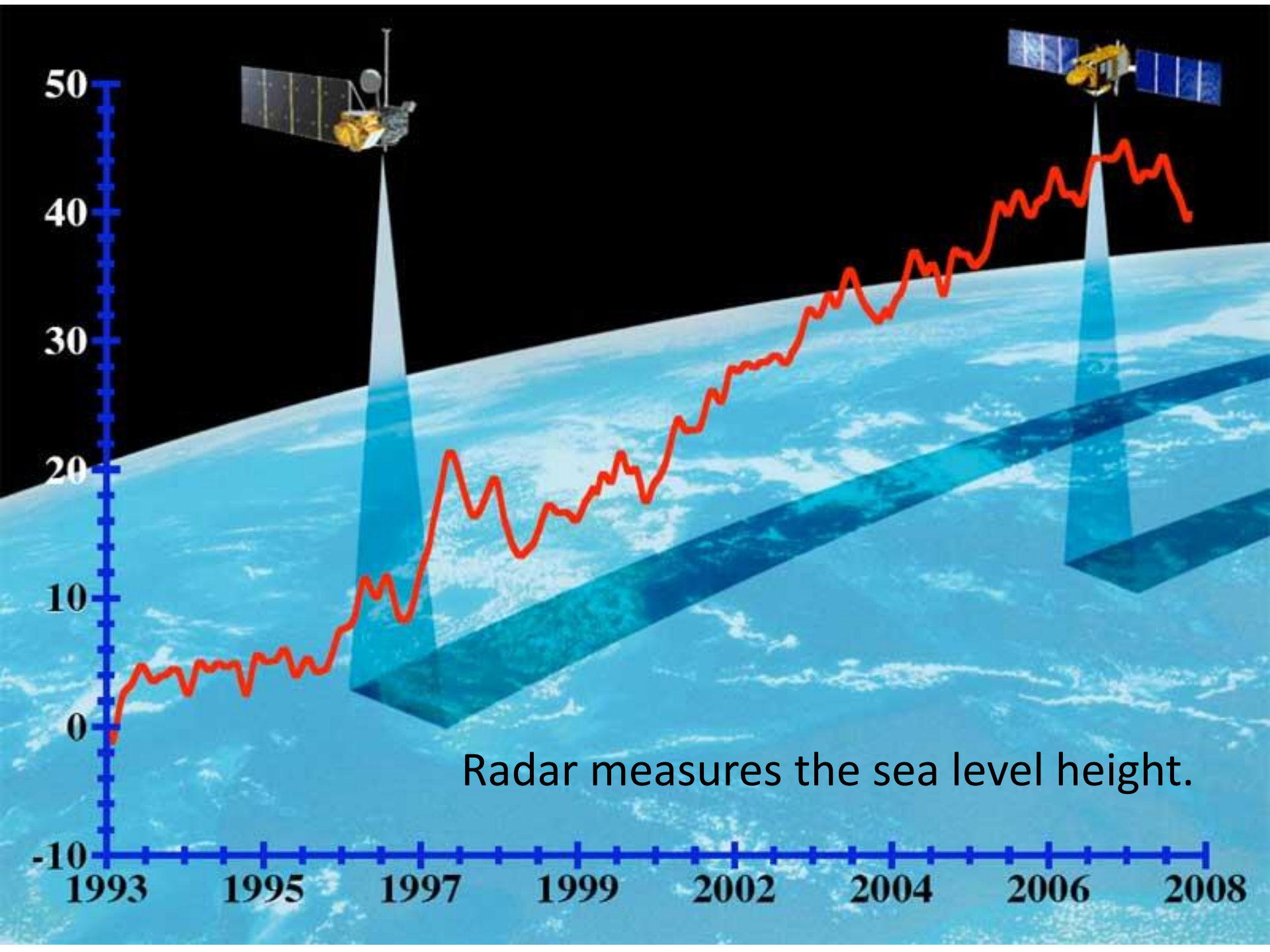

Reality of 18%

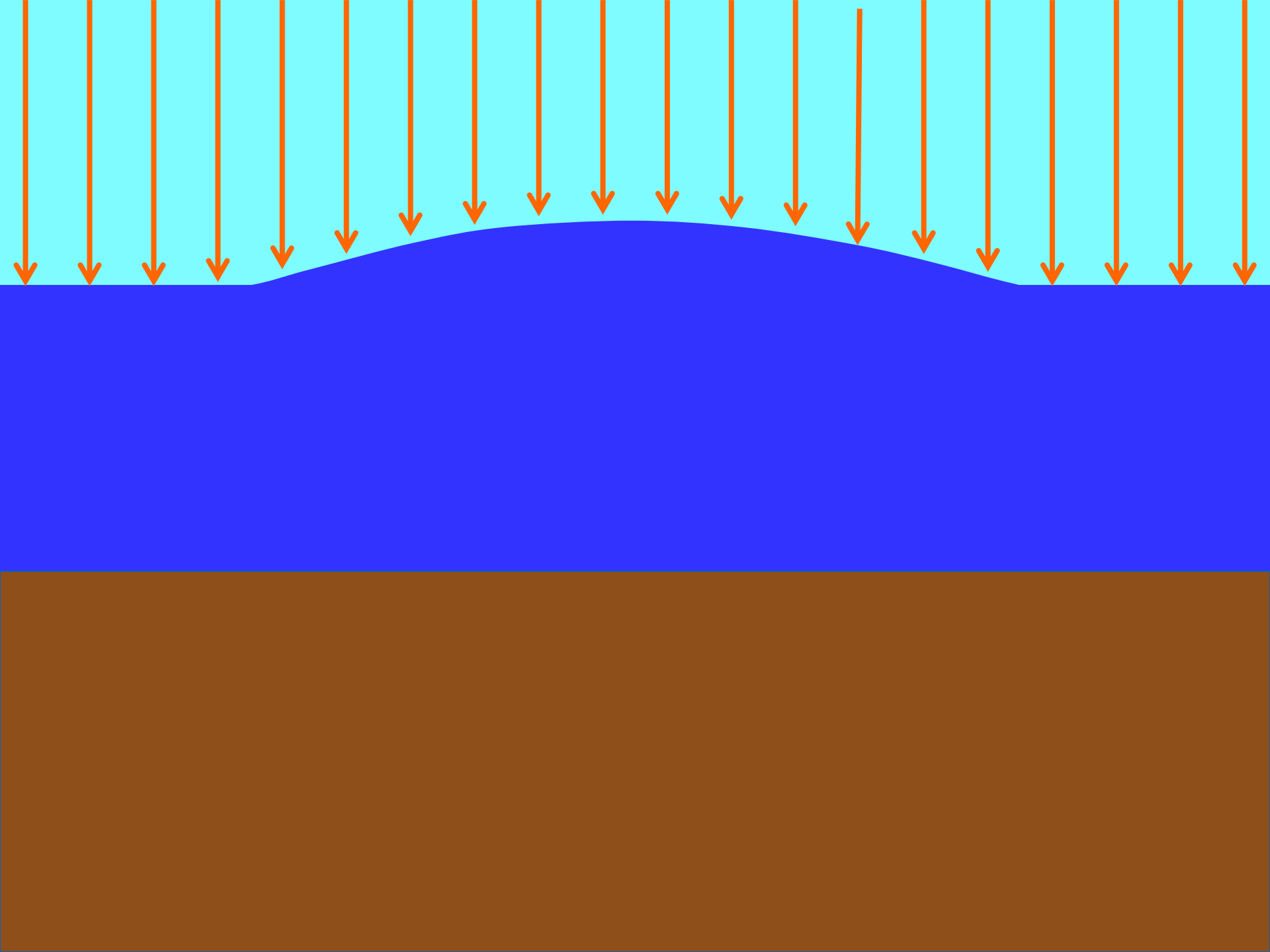

If 100m grid, only 7%


OK, but how can we fill the gaps ?

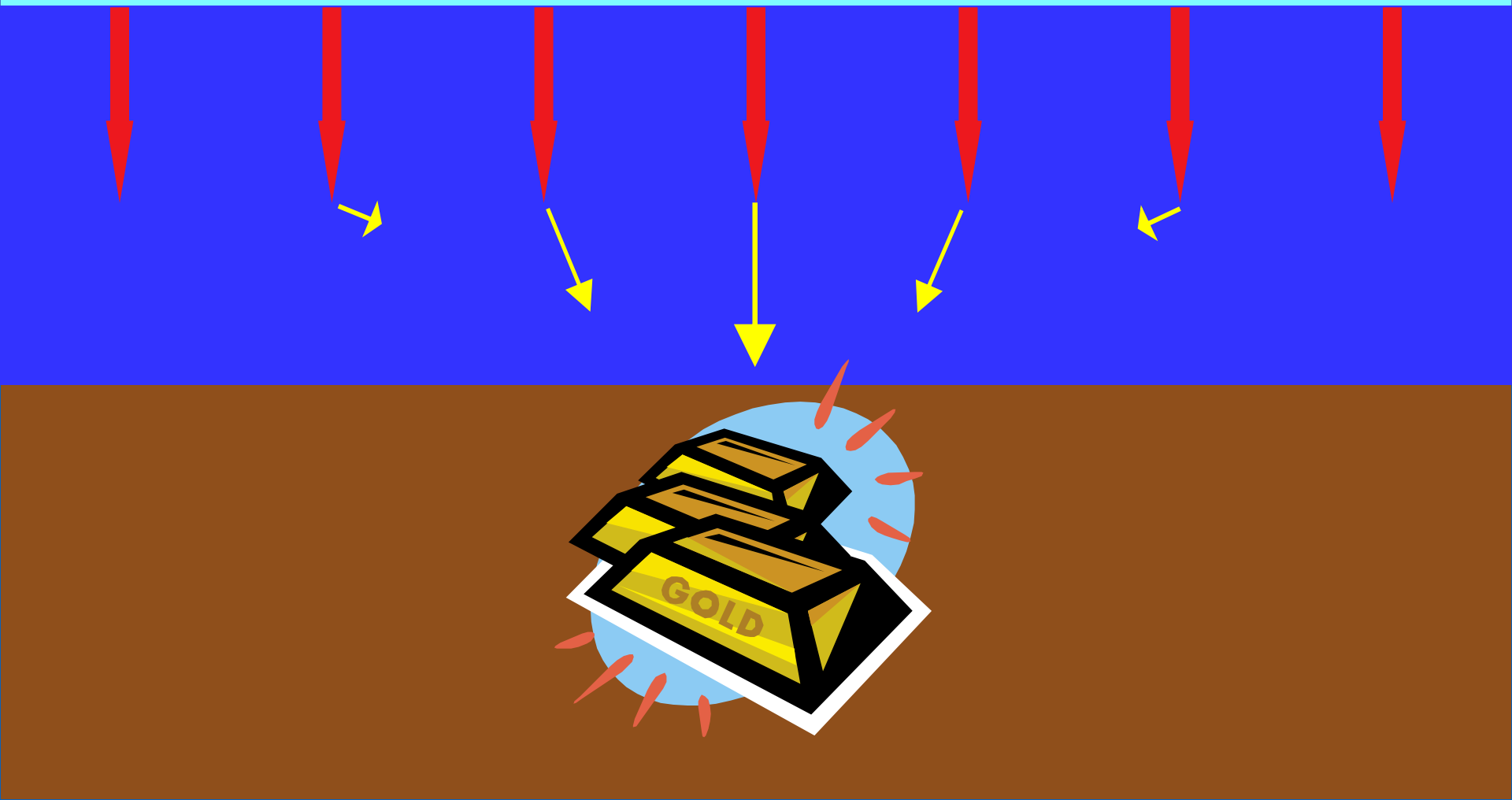
How to fill the gaps

- Once upon a time…
  - Scientists drew contour lines based on the knowledge of geo-morphology, geological evidence, gravity and geo-magnetism.
- 20 years ago…
  - Computer interpolated to create grids based on soundings and hand drawn contours
- These days…
  - Sea level height → gravity → bathymetry

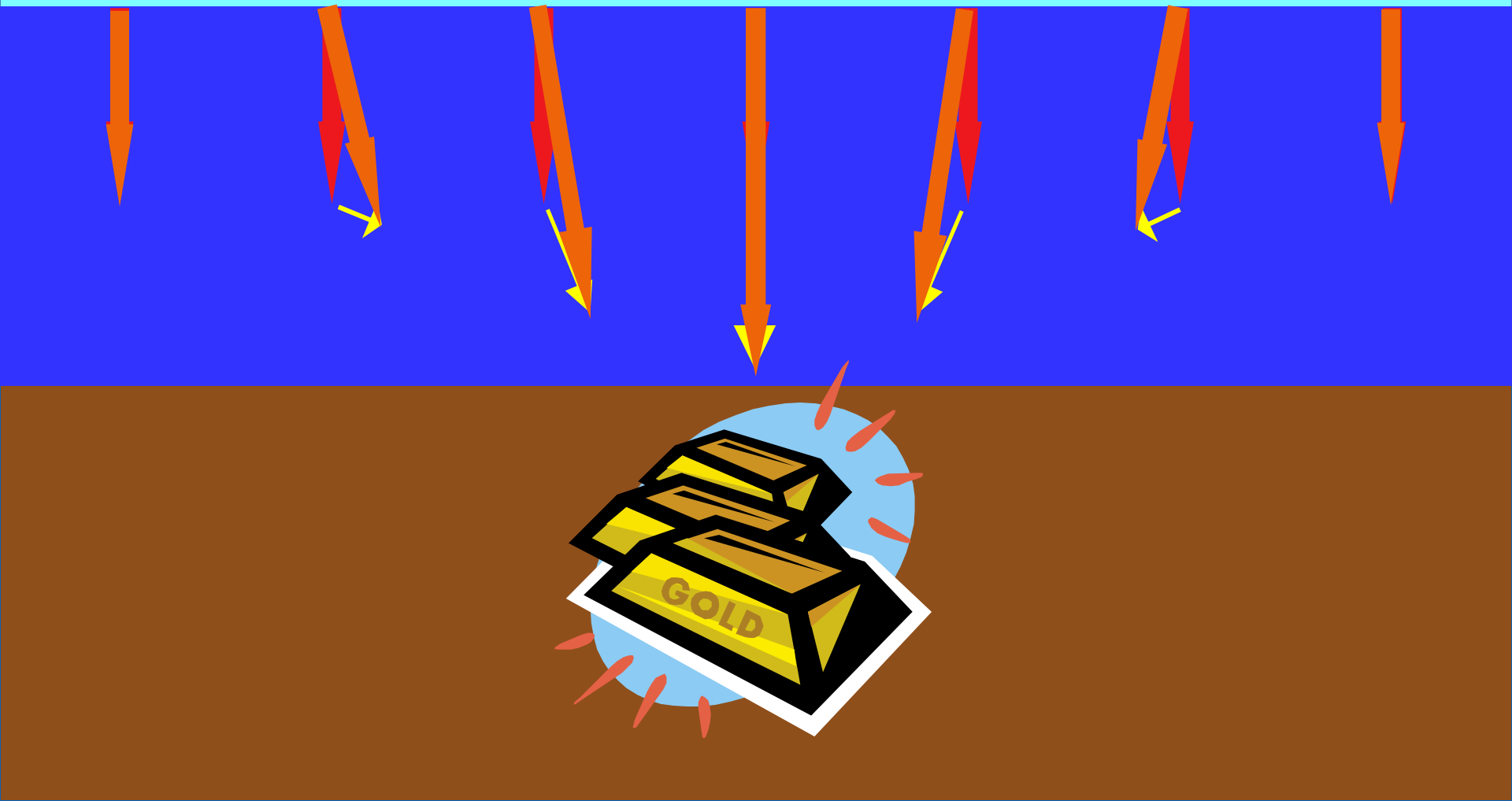

50
40
30
20
10
0
-10
1993
1995
1997
1999
2002
2004
2006
2008
Radar measures the sea level height.

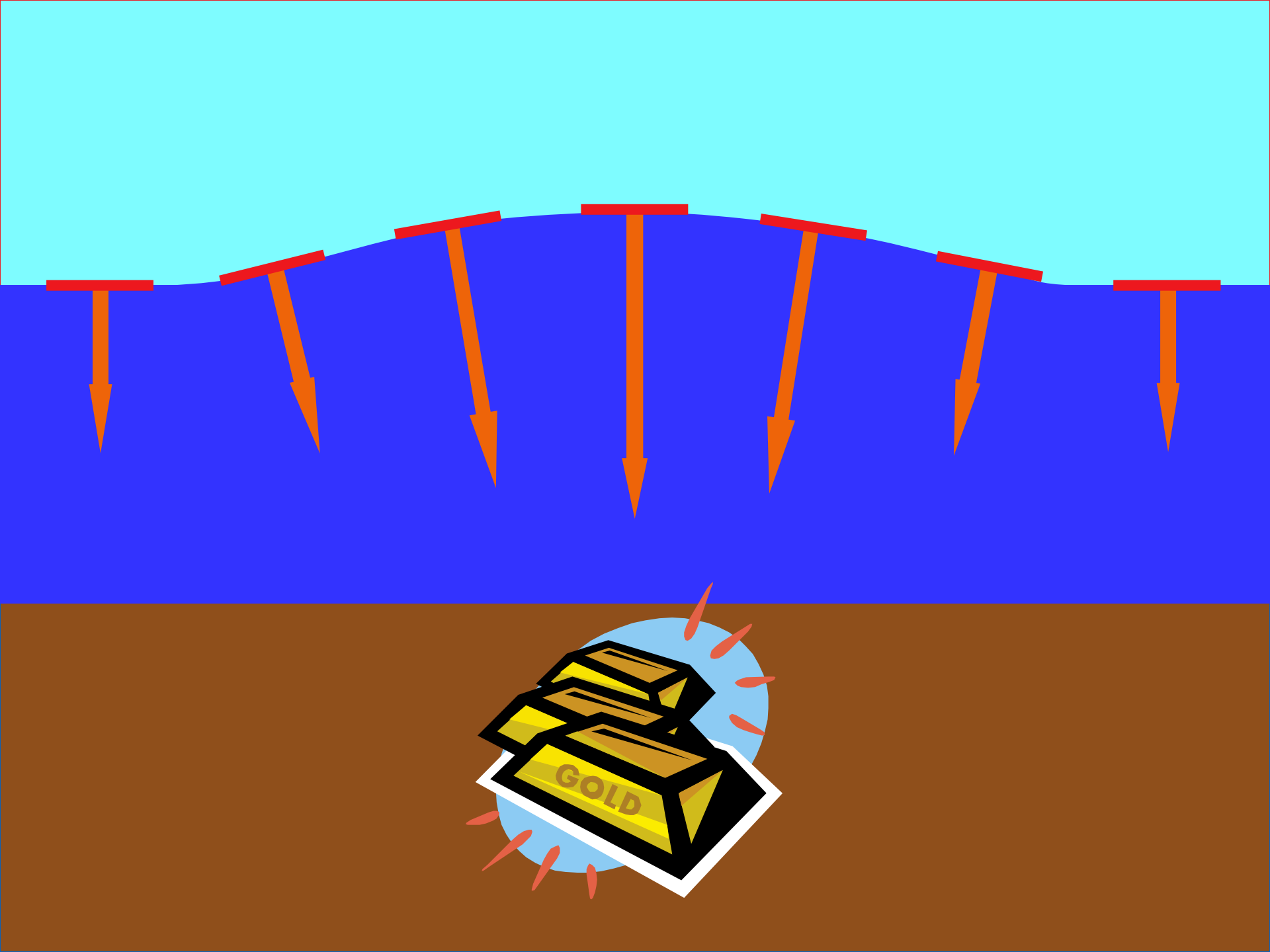


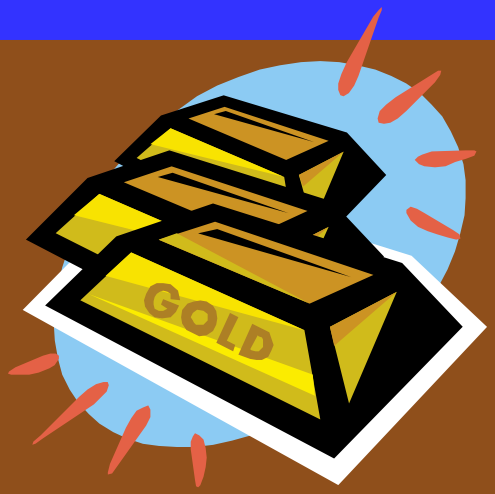
gavity

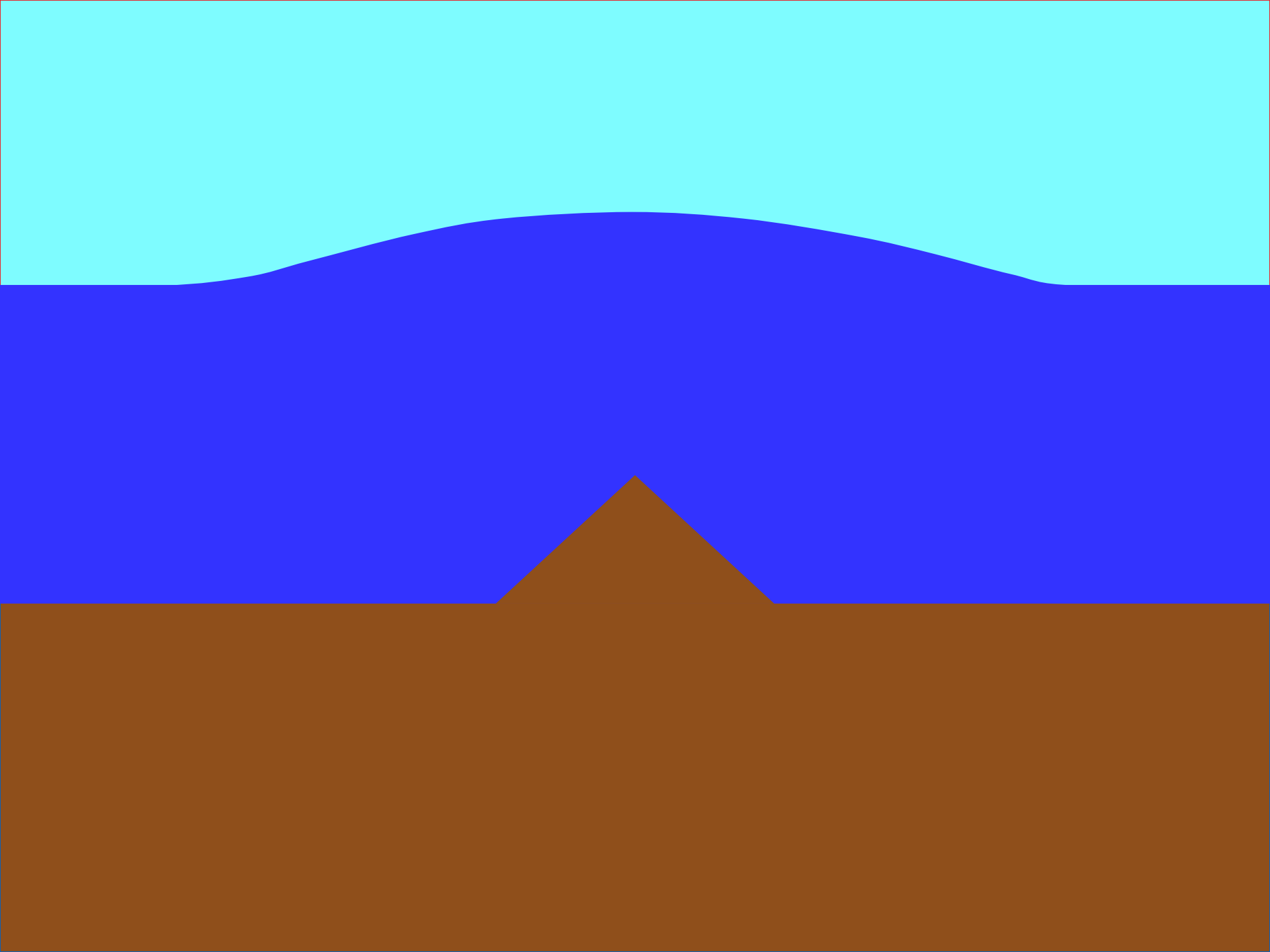


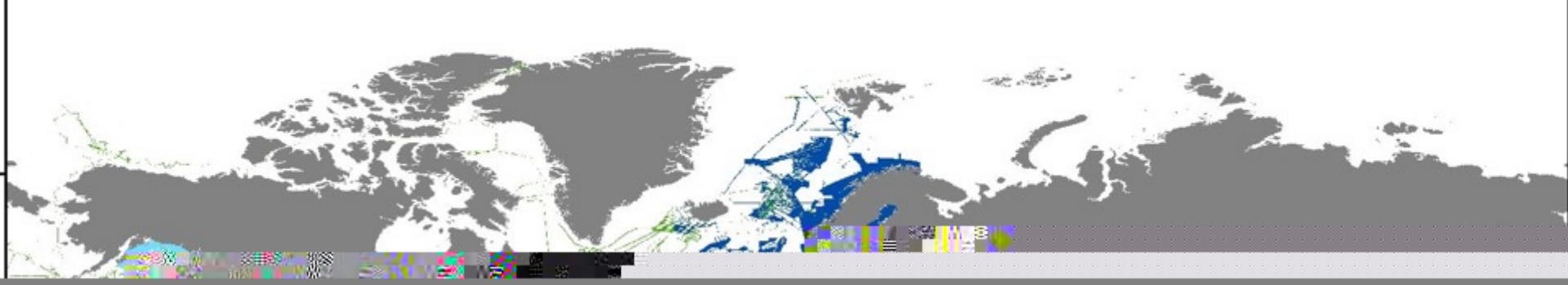
adding two vectors to have one




GOLD

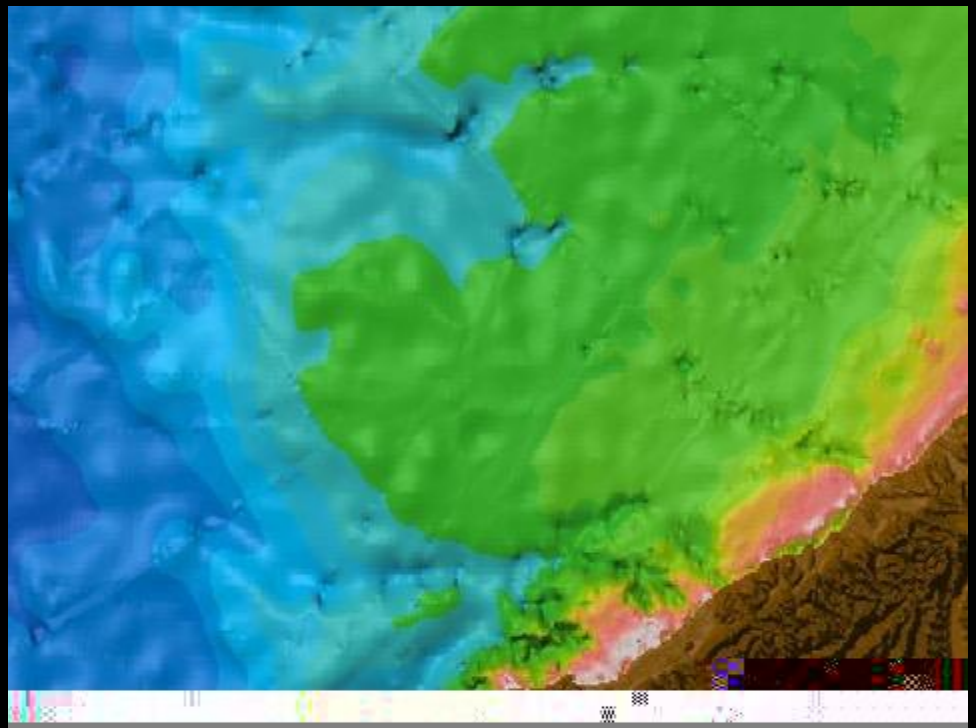

GOLD



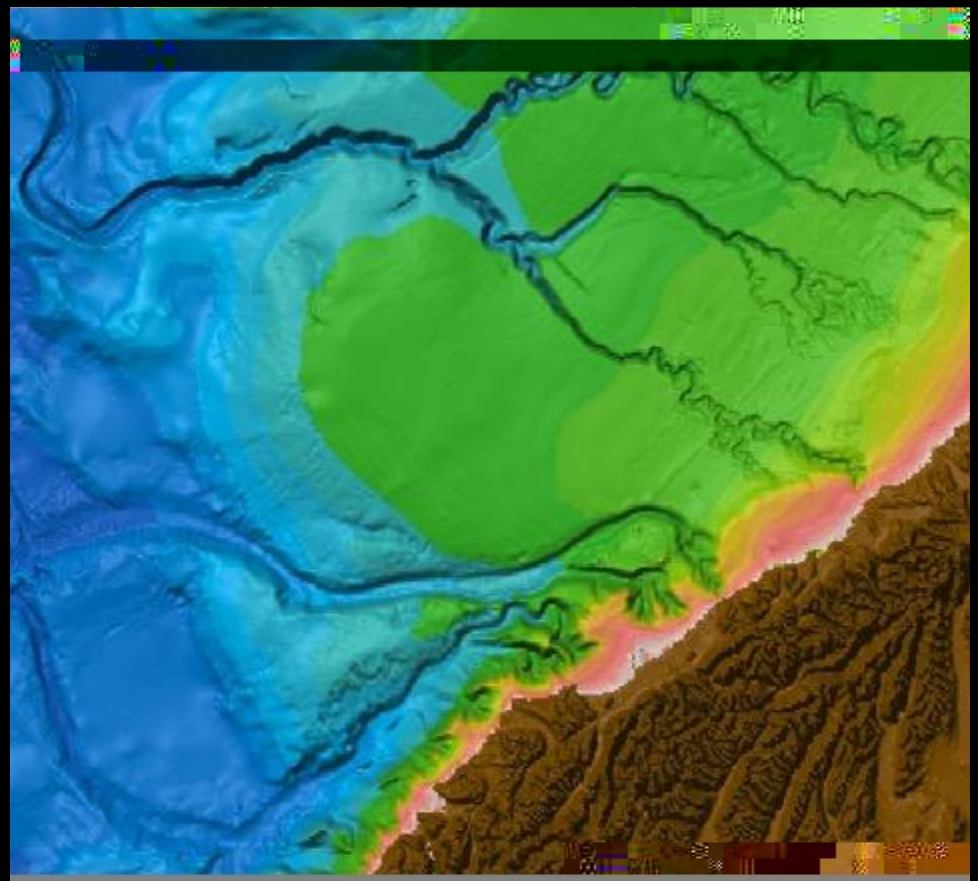


Derived from Satellite altimetry

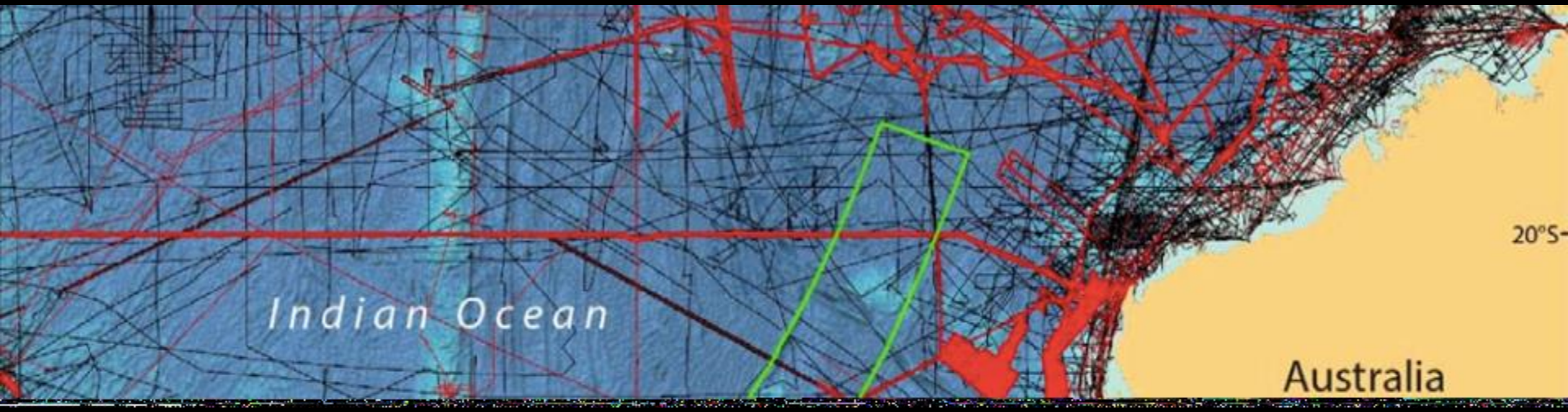
50 km



multi-beam bathymetry



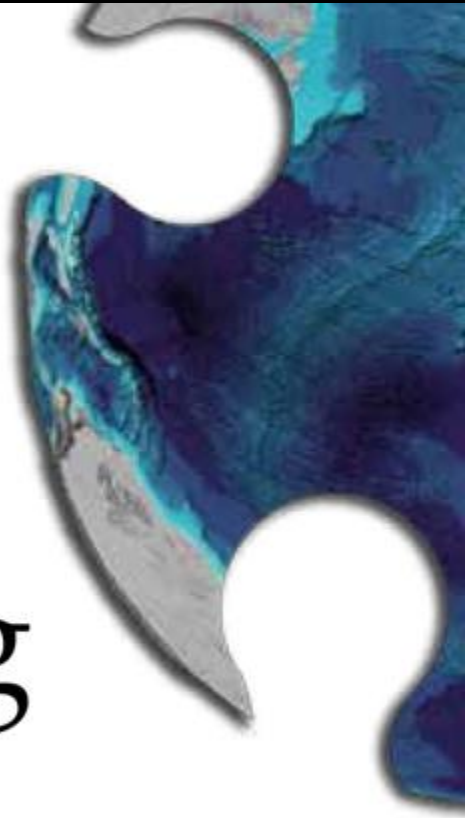
50 km



Of course not!

The Nippon Foundation-GEBCO

Forum *for* Future Ocean Floor Mapping



THE NIPPON FOUNDATION

GEBCO

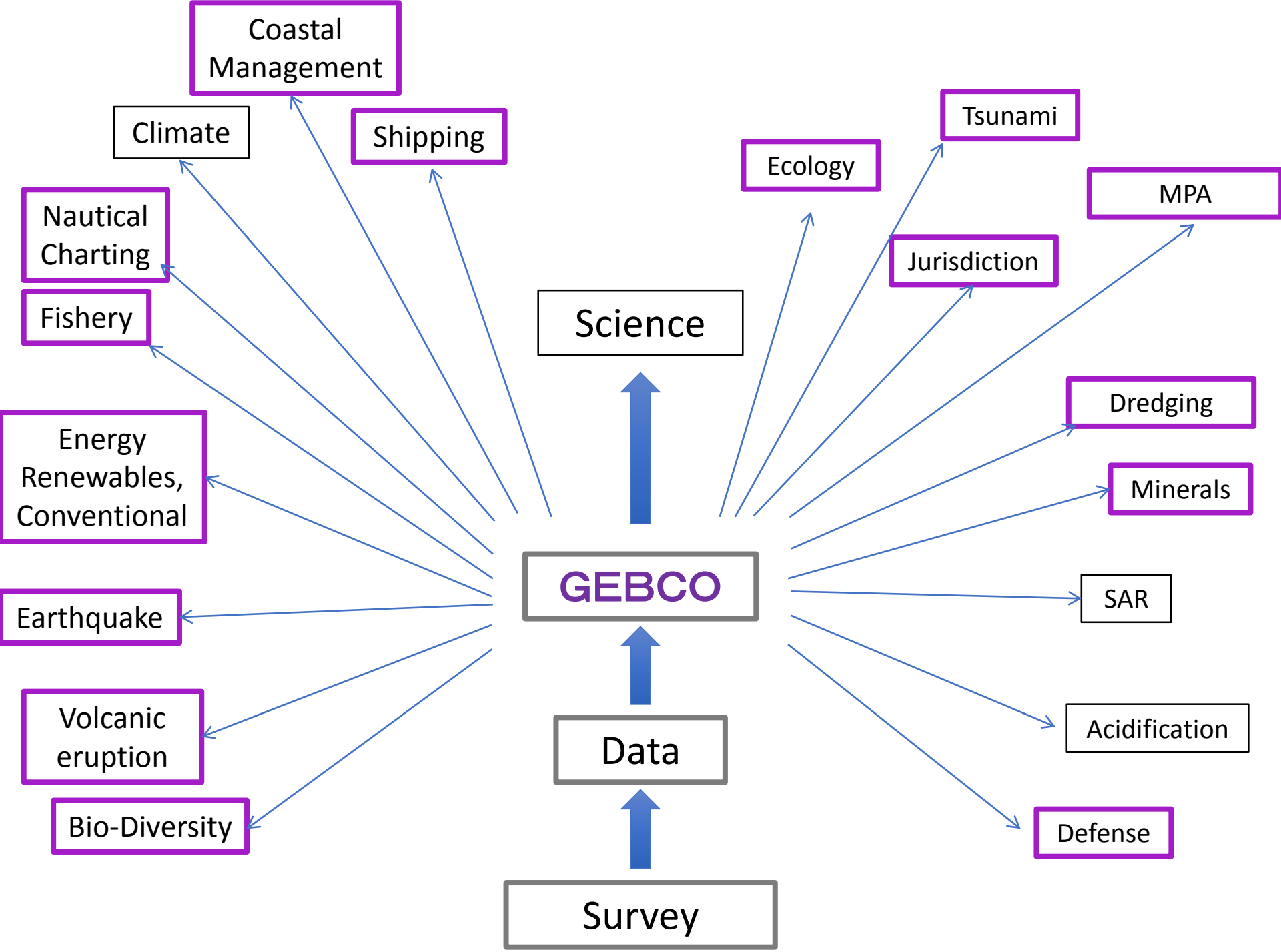
United Nations Educational, Scientific and Cultural Organization

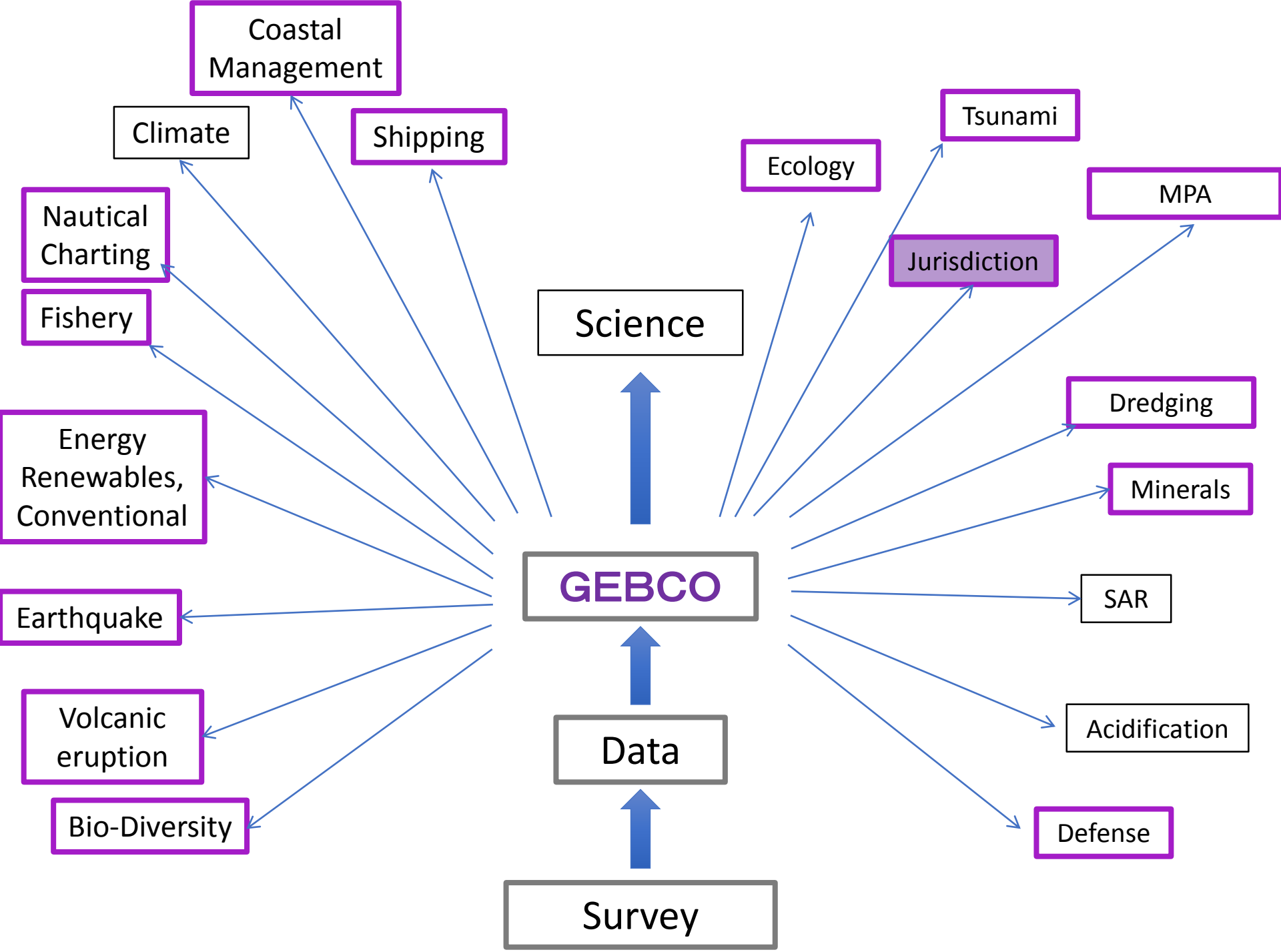
Intergovernmental Oceanographic Commission

- Strong concern on the future health of the ocean.
- Frustration to the very slow progress on ocean mapping


Musée
océanographique
de Monaco


Musée
océanographique
de Monaco


Coastal Management
Climate
Shipping
Nautical Charting
Fishery
Energy Renewables, Conventional
Earthquake
Volcanic eruption
Bio-Diversity
Ecology
Tsunami
MPA
Jurisdiction
Science
Dredging
Minerals
GEBCO
SAR
Acidification
Data
Defense
Survey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UNCLOS and bathymetry

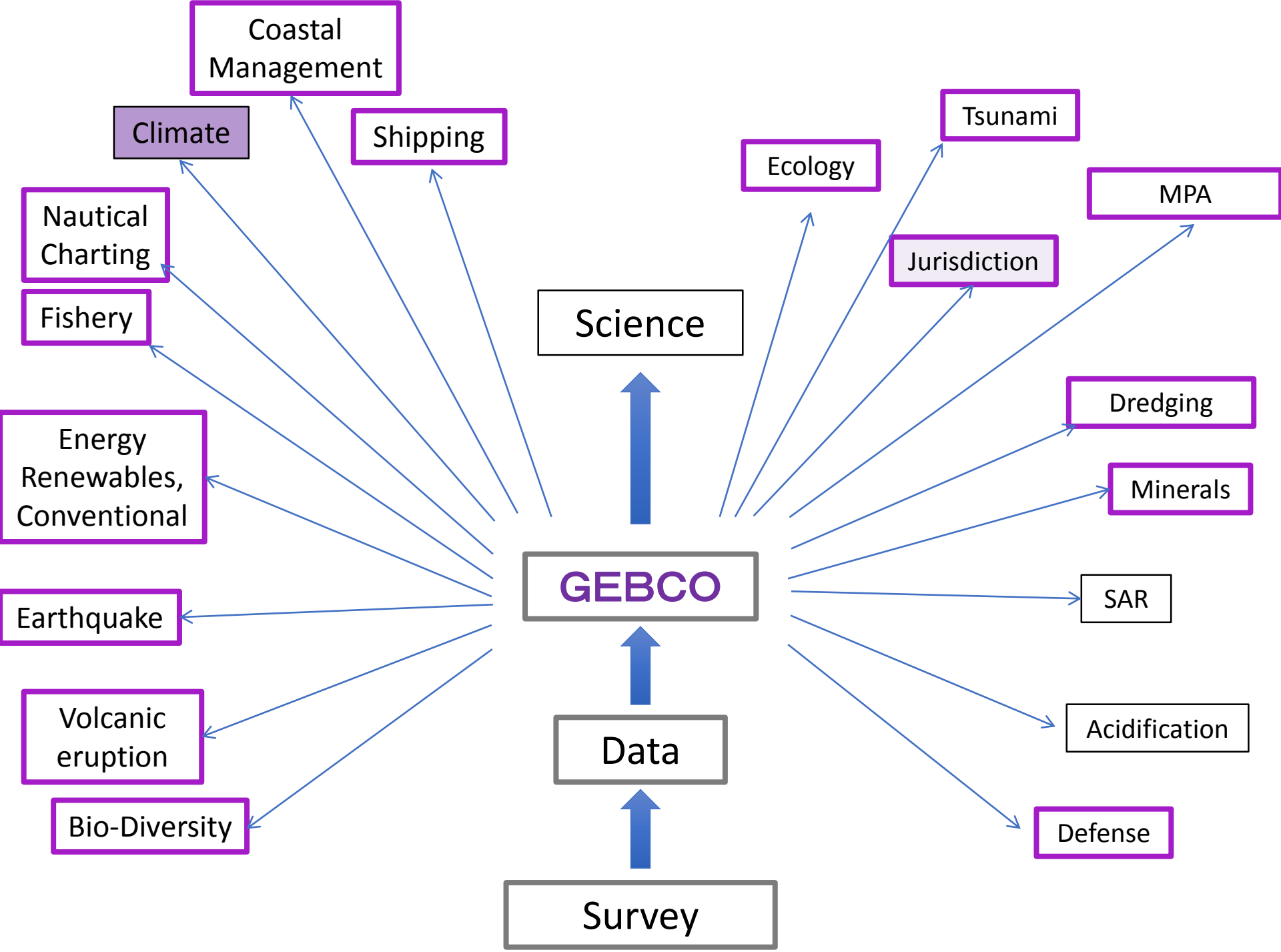
- Territorial baseline
- Extended continental shelf

Low water lines

natural prolongation

foot of the slope

2500m constraint line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Vertical mixing

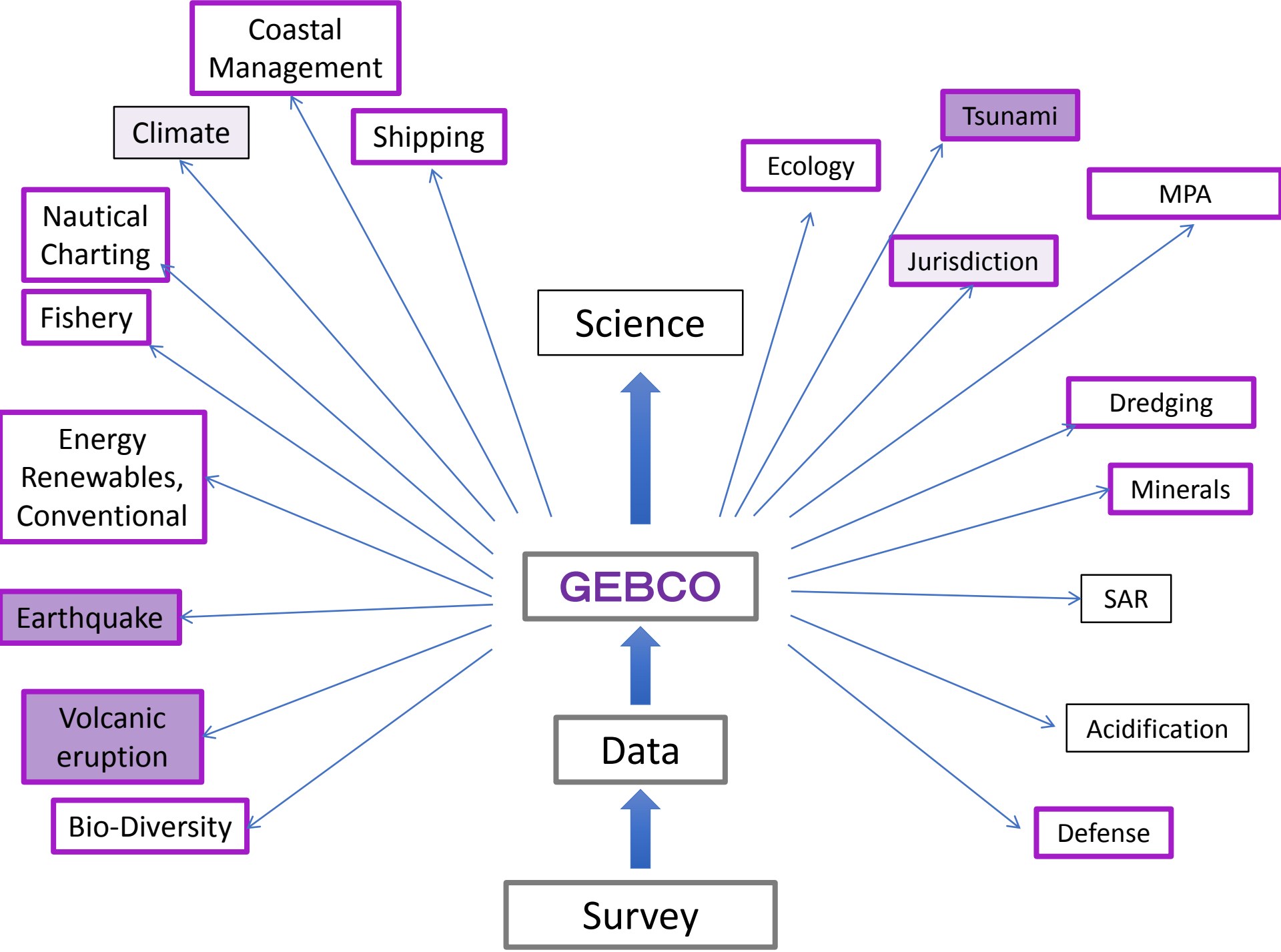
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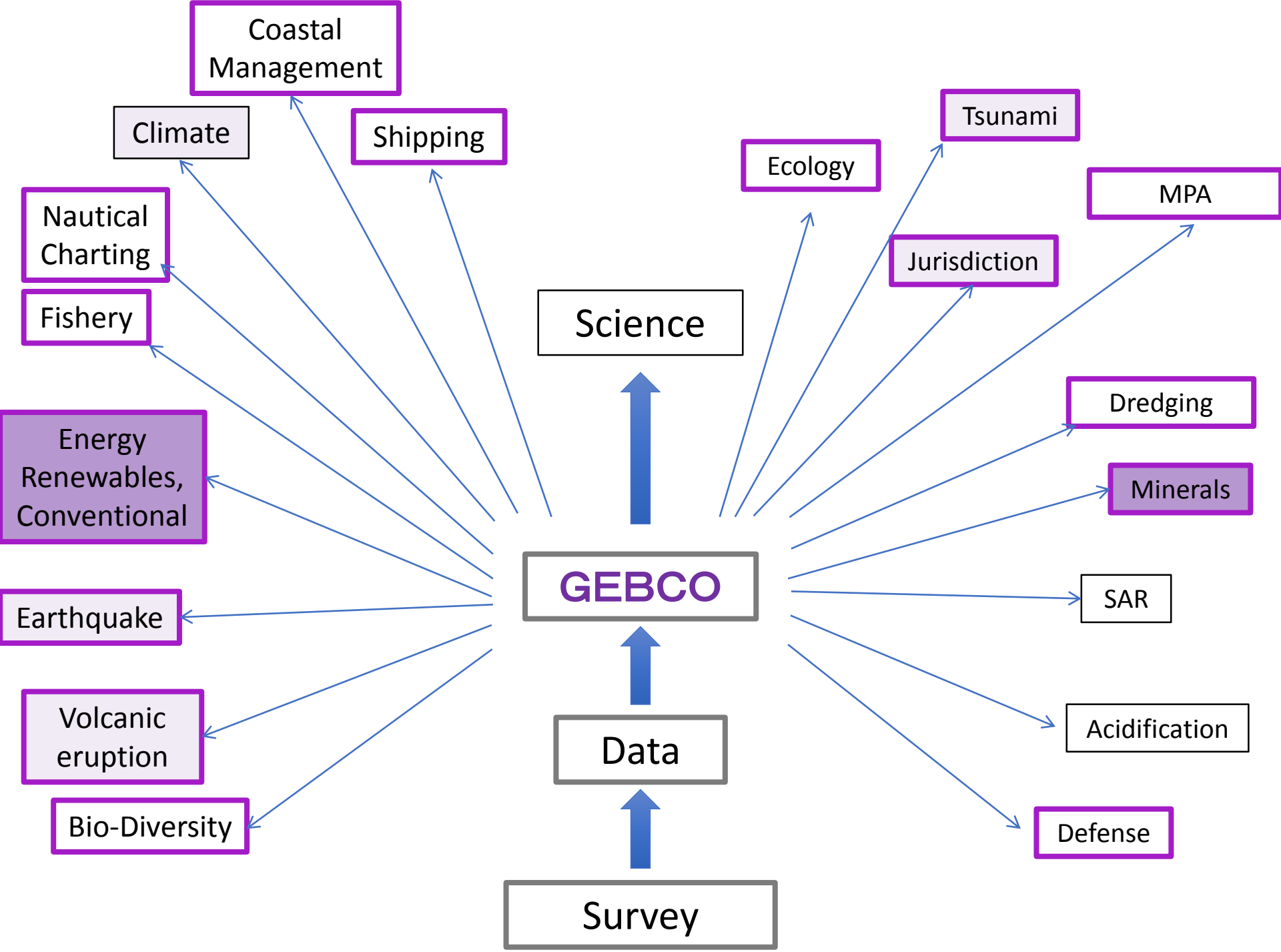
Plate motion

- Active faults
- Volcanos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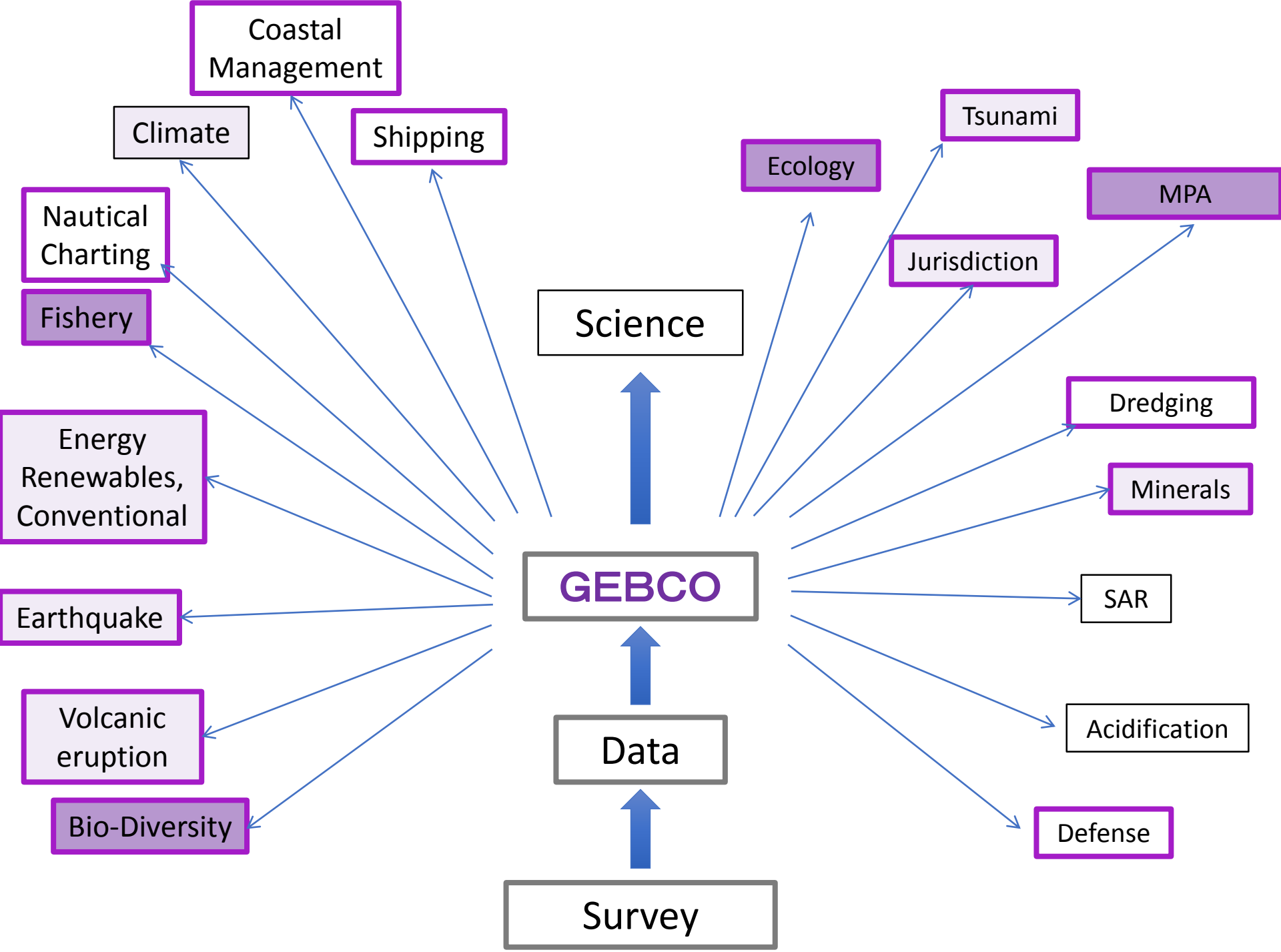
Resources

- Conventional
  - Oil, Gas, Gas Hydrate
- Renewable
  - Wind
  - Tide
  - Tidal current
  - Ocean current
  - Ocean Thermal (OTEC)
- Minerals
  - Ferro-Manganese Nodule, Crust
  - Poly-Metallic Sulfide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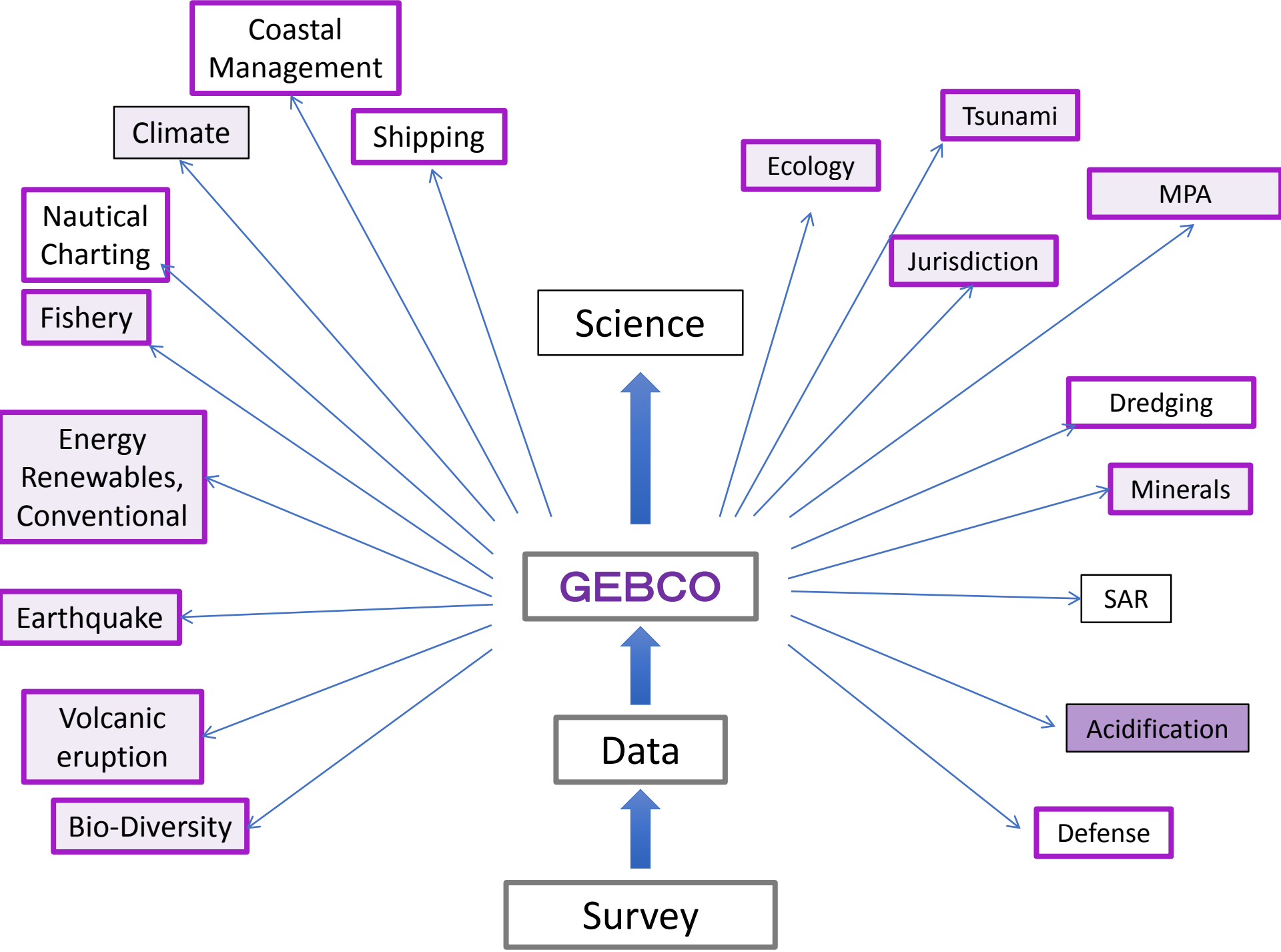
Bio Resources

- Upwelling
- Habitat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Ocean Acidification

- Sea bottom volcanic activities

Seabed 2030

Forum for Future Ocean Floor Mapping held in Monaco in 2016 was the start of Seabed 2030

- Necessity of detailed bathymetry was emphasized,
- The Nippon Foundation declared their wish to support the challenge for the mapping

At the Ocean Conference held in New York in 2017, Chairman of The Nippon Foundation, Yohei Sasakawa, declared their full support for Seabed 2030.

Seabed 2030 officially started on February 20th 2017.

Seabed 2030 ･･･ its outline

The Nippon Foundation - GEBCO Seabed 2030

- is a global program with the focused goal of compiling Digital Bathymetric Model (DBM), which is;
  - openly available
  - at the highest resolution possible
  - from the coast to the deepest trenches
  - by the year 2030
  - to leave no features of the World Ocean floor larger than 100 m unmapped.

Seabed 2030 ･･･ its objective

- to empower the world to
  - make policy decisions,
  - use the ocean sustainably and
  - undertake scientific research

  based on detailed bathymetric information of the Earth’s seabed.

How to increase data

- Dig up existing data
- Create new data flow, such as;
  - crowd sourced bathymetry (CSB)
  - Data harvesting from ENC
  - Expansion of GEBCO family
- Include data from new survey technologies, such as;
  - Satellite-imagery derived bathymetry (SDB),
  - lidars,
  - AUVs, ROVs, gliders, data buoys,
  - ultra-narrow beam echo sounder from a barge

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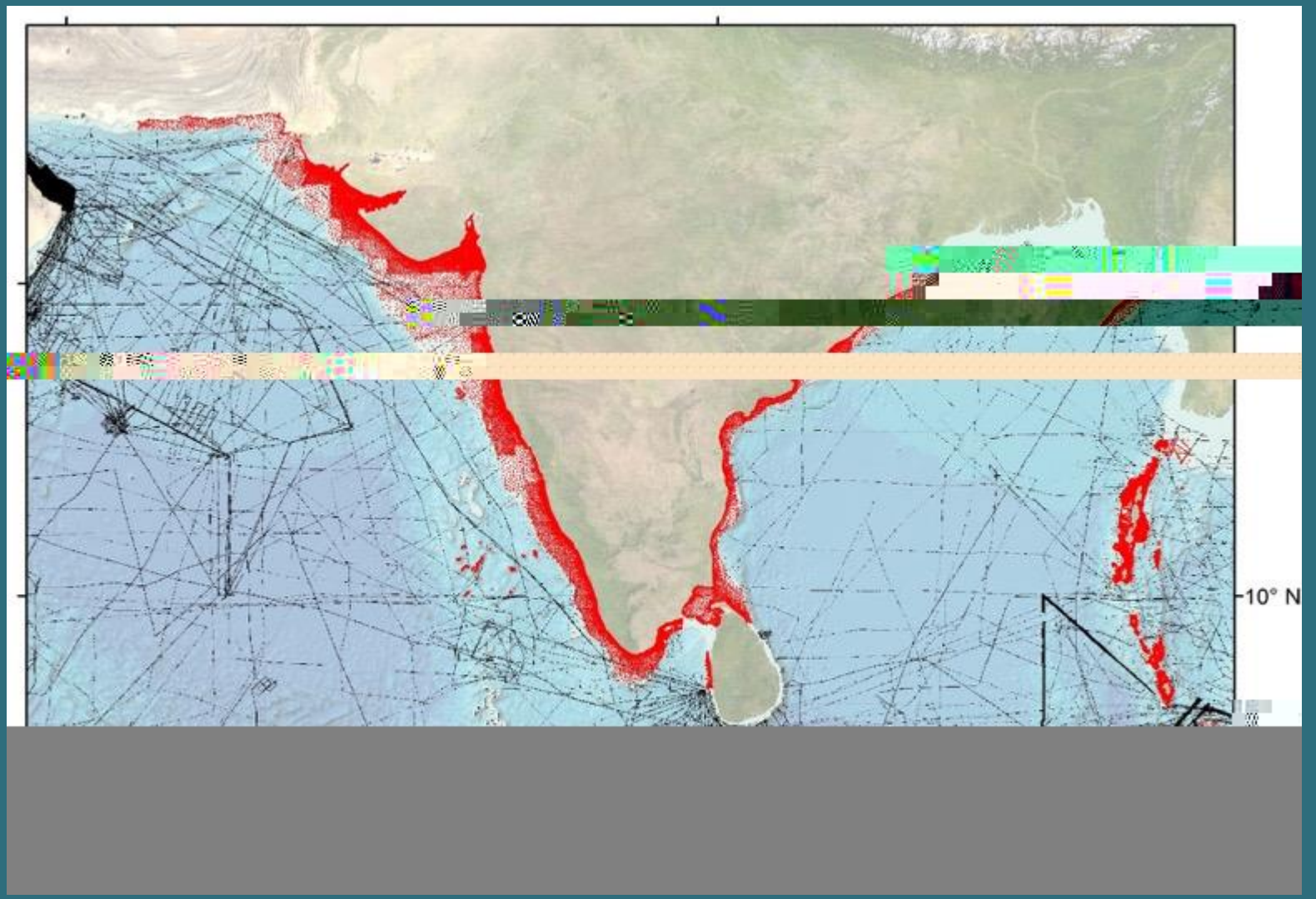
How to help improve global bathymetric models

Coverage of source bathymetry data used to develop GEBCO's global grid in the region of the *North Indian Regional Hydrographic Commission.*



Red: ENC-Soundings Black: Grid cells in the GEBCO grid constrained by ship-track soundings

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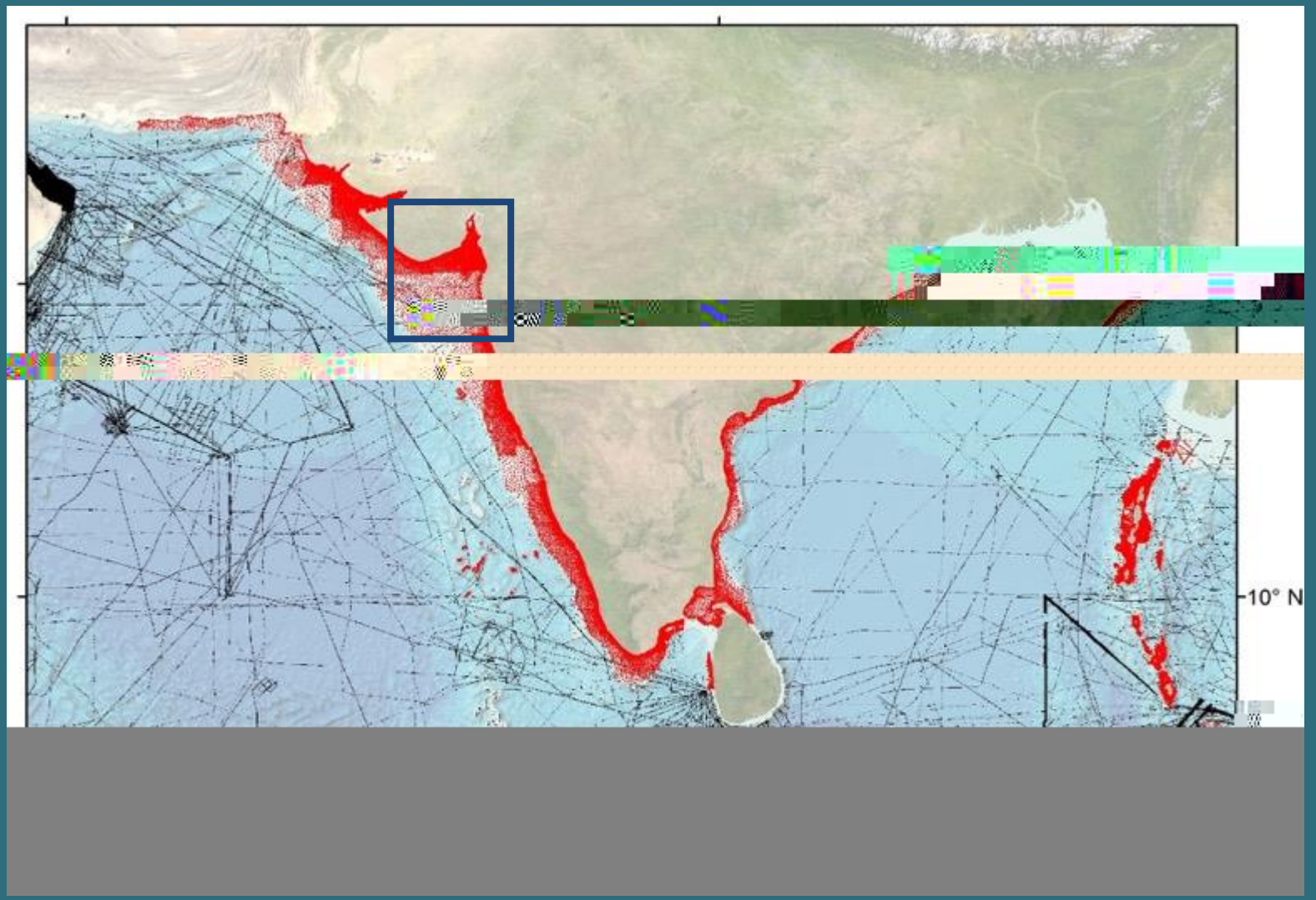

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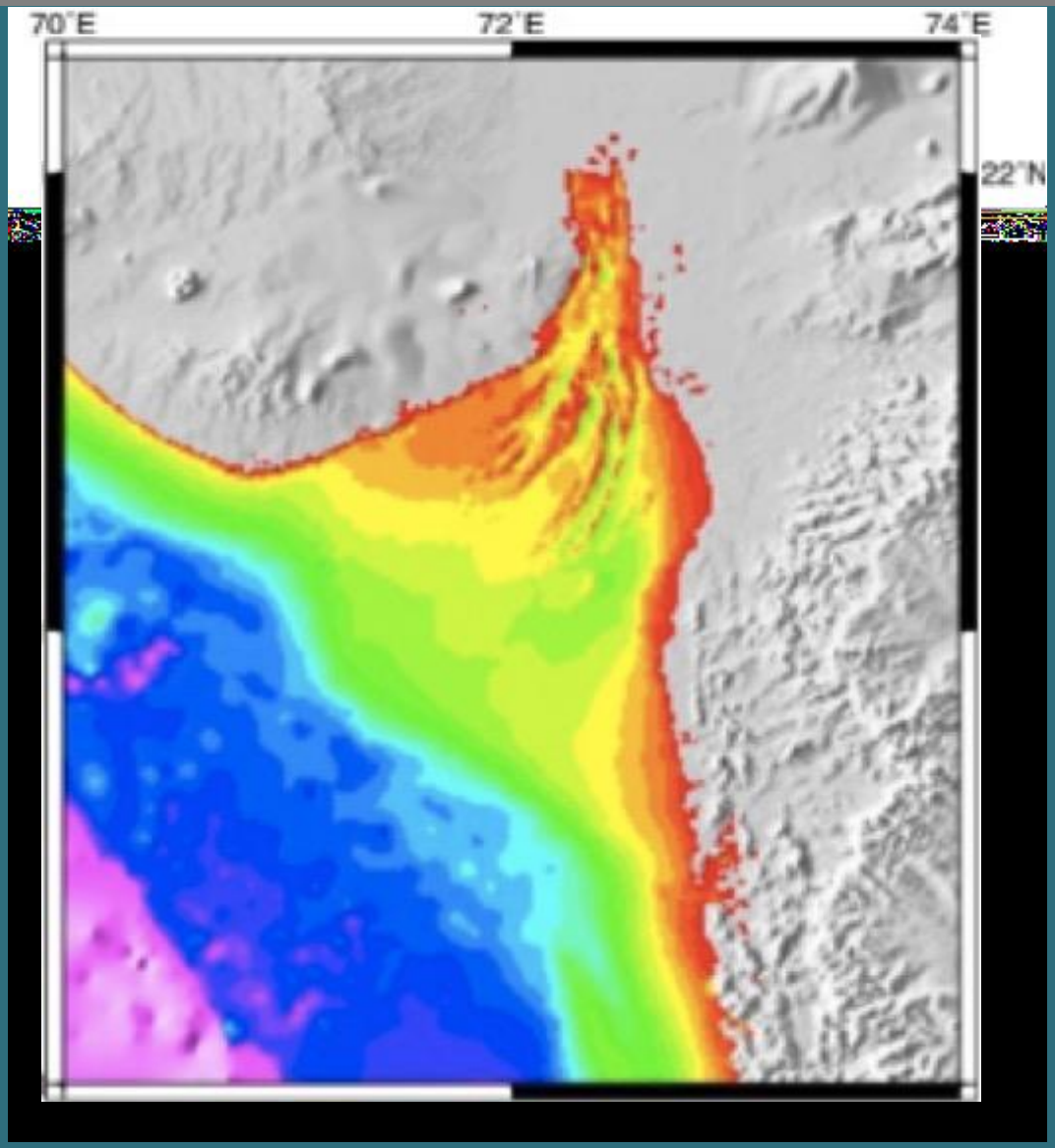
Shallow water bathymetry initiative



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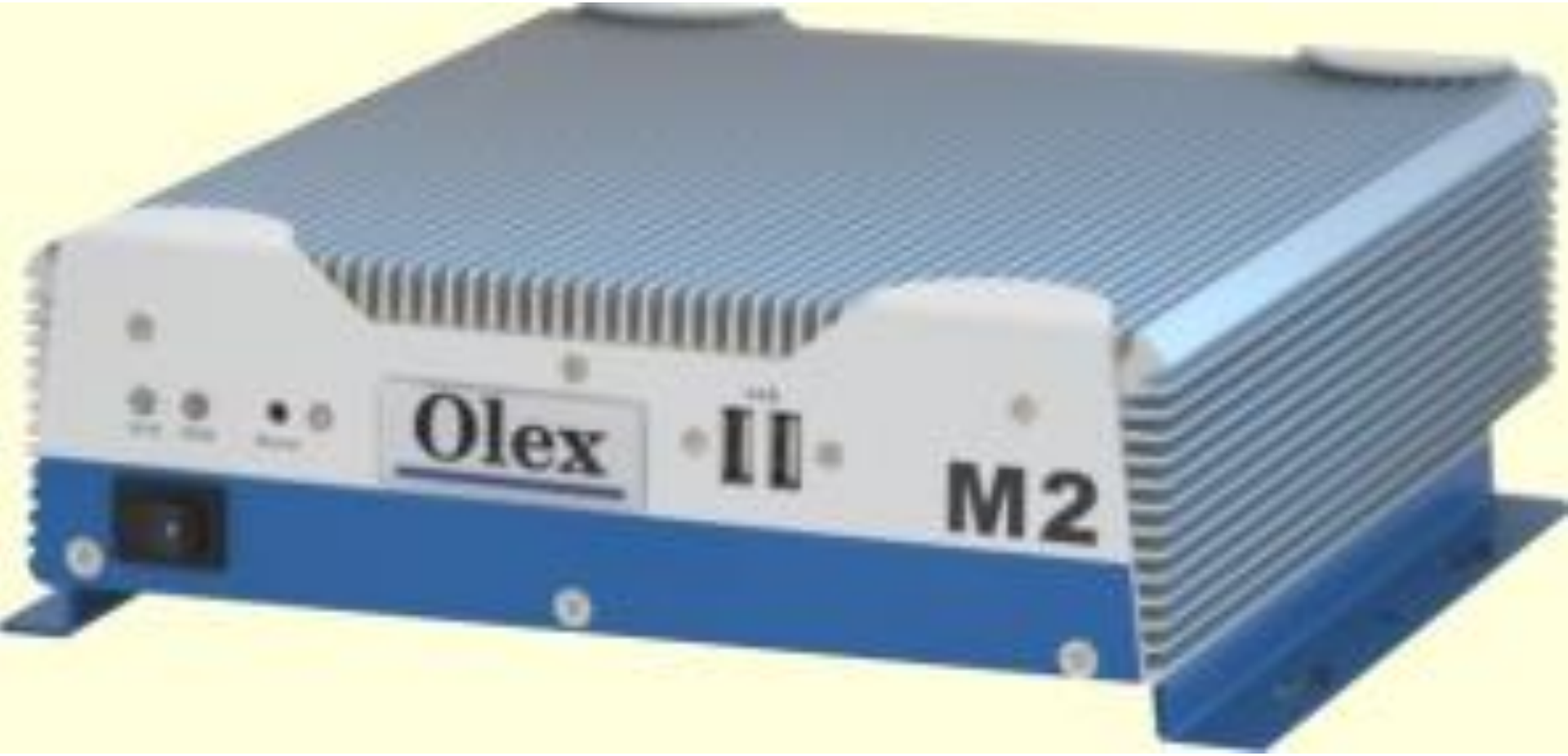
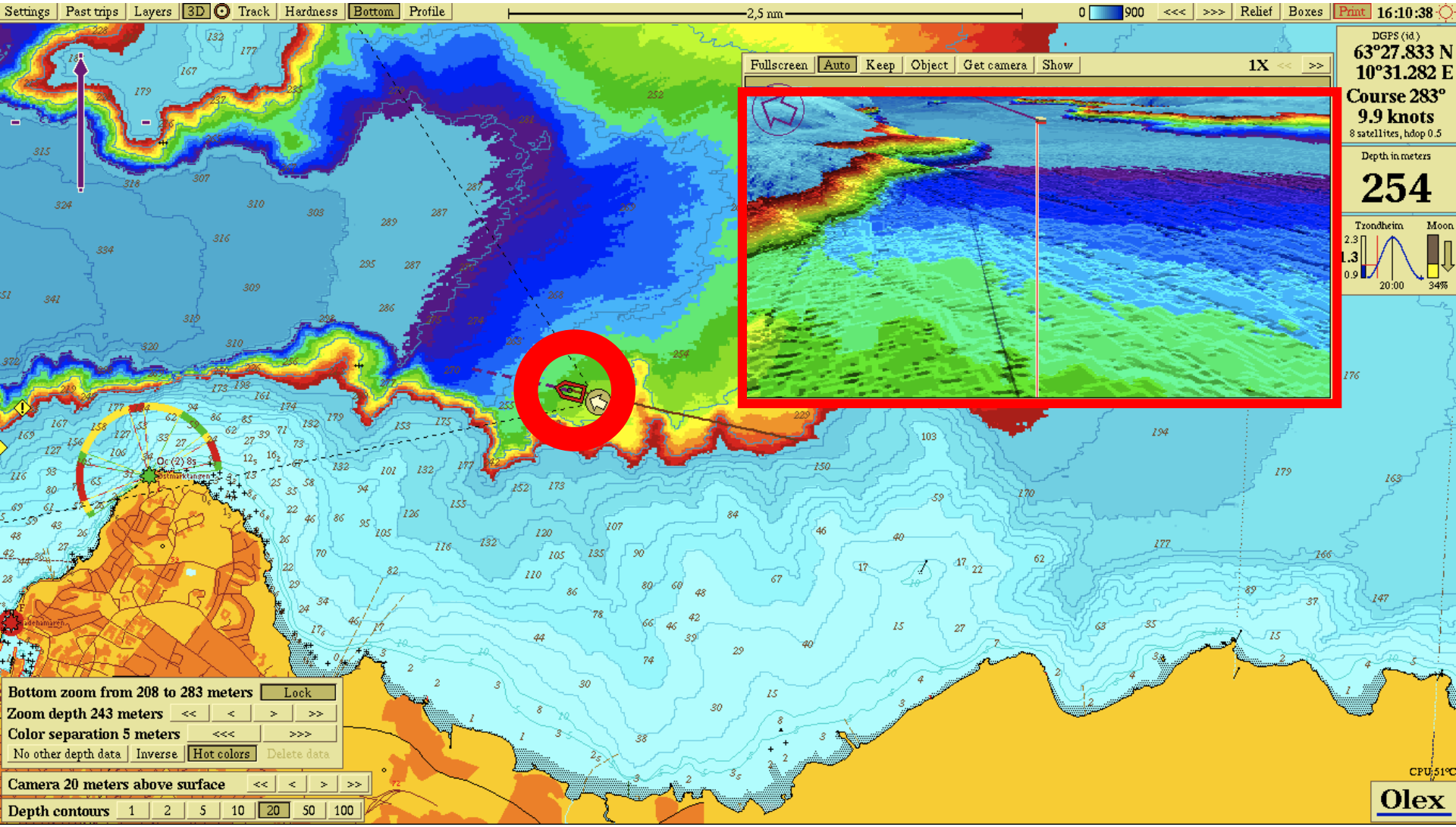
For esample, say,

- OLEX is a map visualization software and the name of the company which operates the software.
- Depth data sent by fishery vessels worldwide are assimilated into the OLEX database continually and the resultant data set is sent back to the vessels.
- Number of the data talks.


Olex
II
M2


Settings
Past trips
Layers
3D
Track
Hardness
Bottom
Profile
2,5 nm
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900
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Relief
Boxes
Print
16:10:38
Fullscreen
Auto
Keep
Object
Get camera
Show
1X
<<
>>
DGPS (id.)
63°27.833 N
10°31.282 E
Course 283°
9.9 knots
8 satellites, hdop 0.5
Depth in meters
254
Trondheim
Moon
2.3
1.3
0.9
20:00
34%
Bottom zoom from 208 to 283 meters
Lock
Zoom depth 243 meters
<<
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>
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Color separation 5 meters
<<<
>>>
No other depth data
Inverse
Hot colors
Delete data
Camera 20 meters above surface
<<
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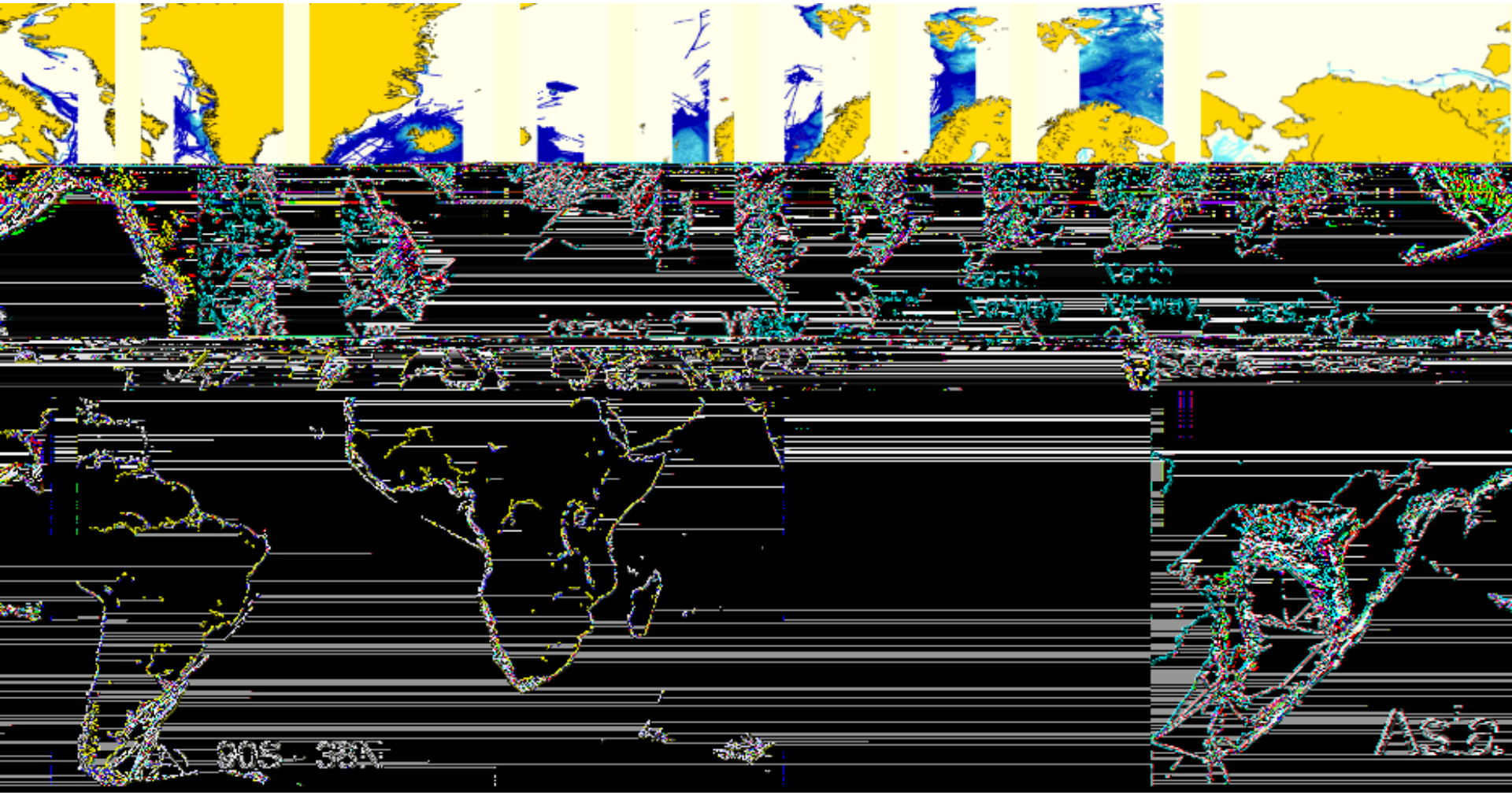
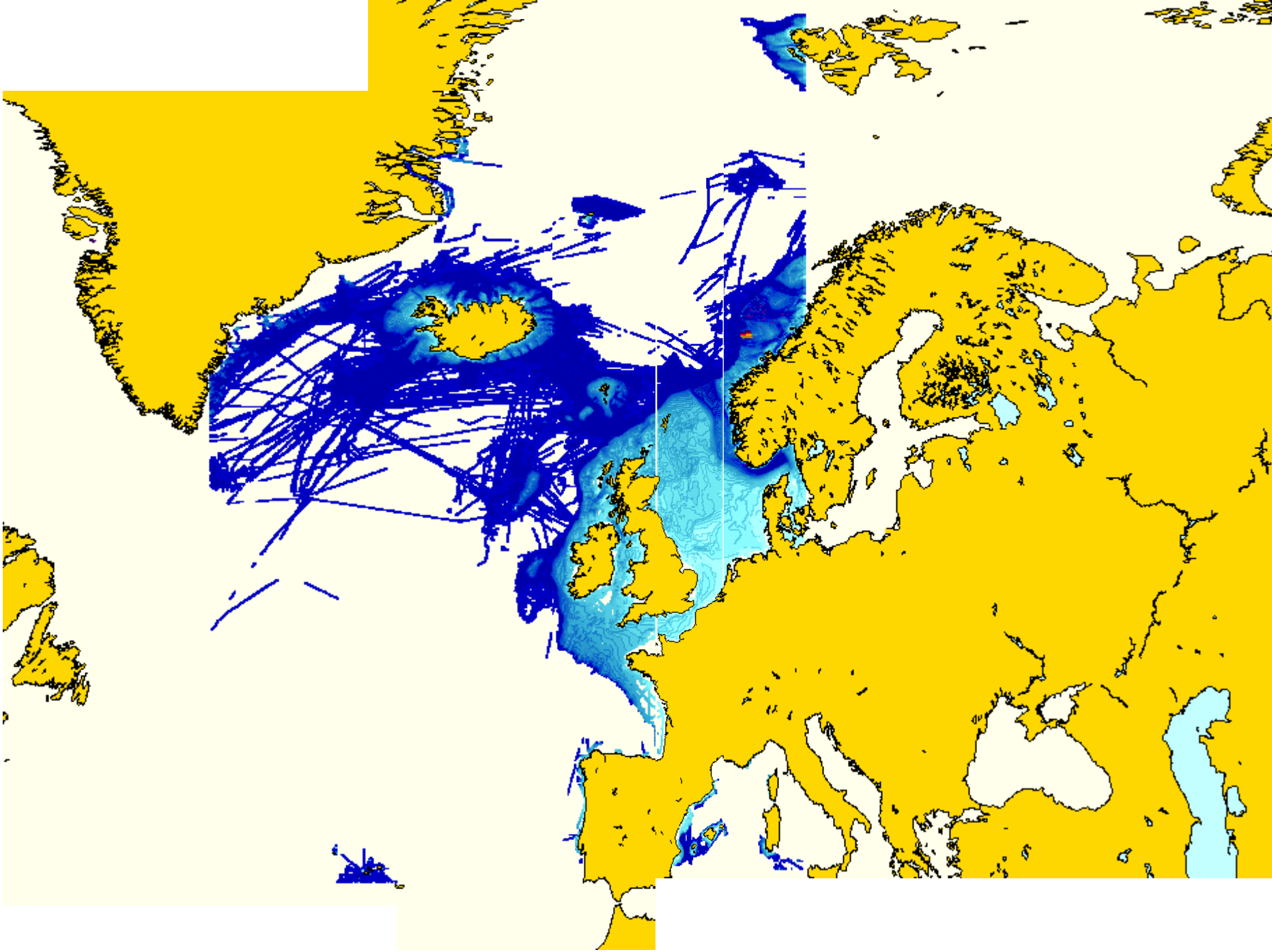
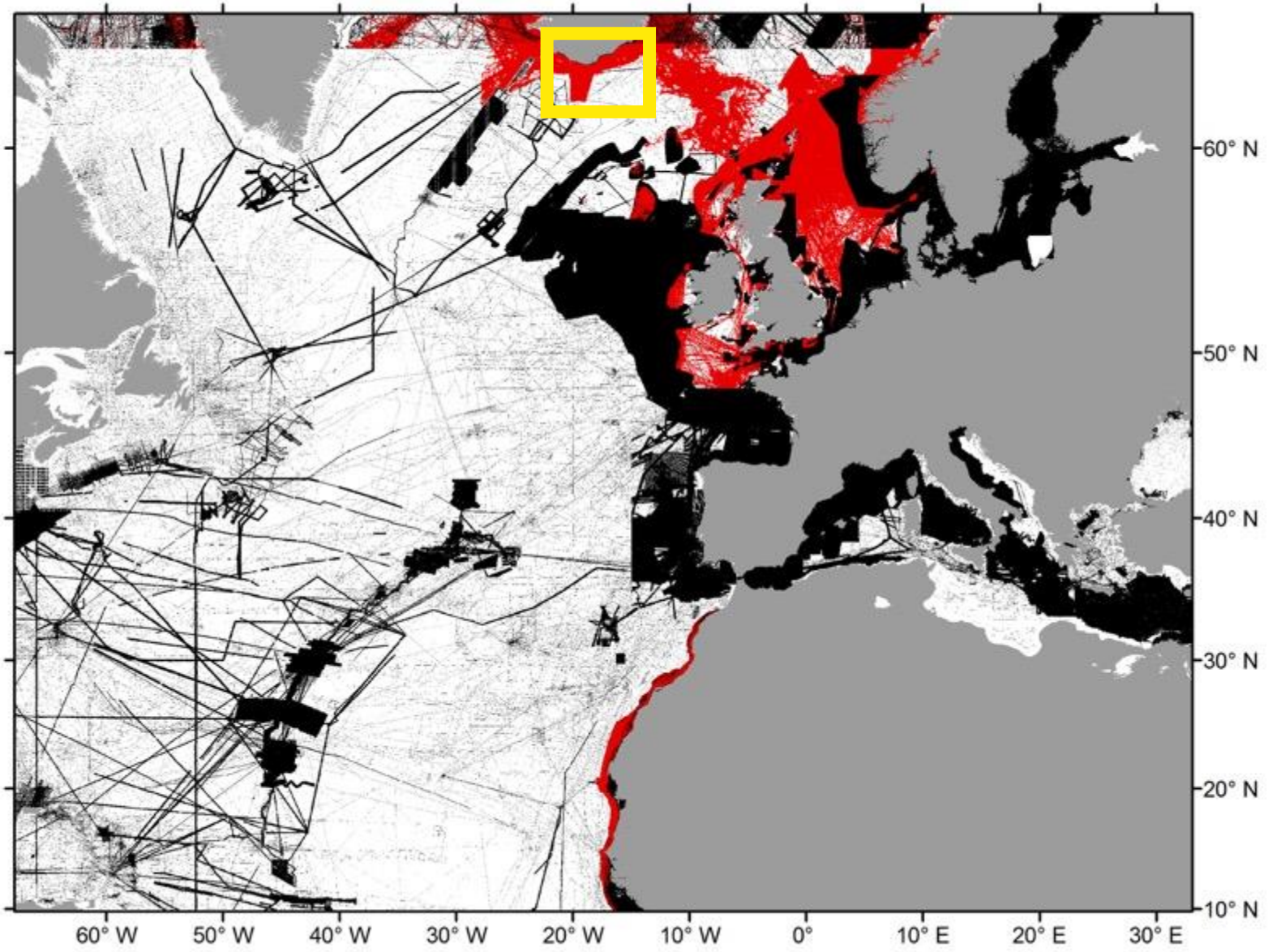
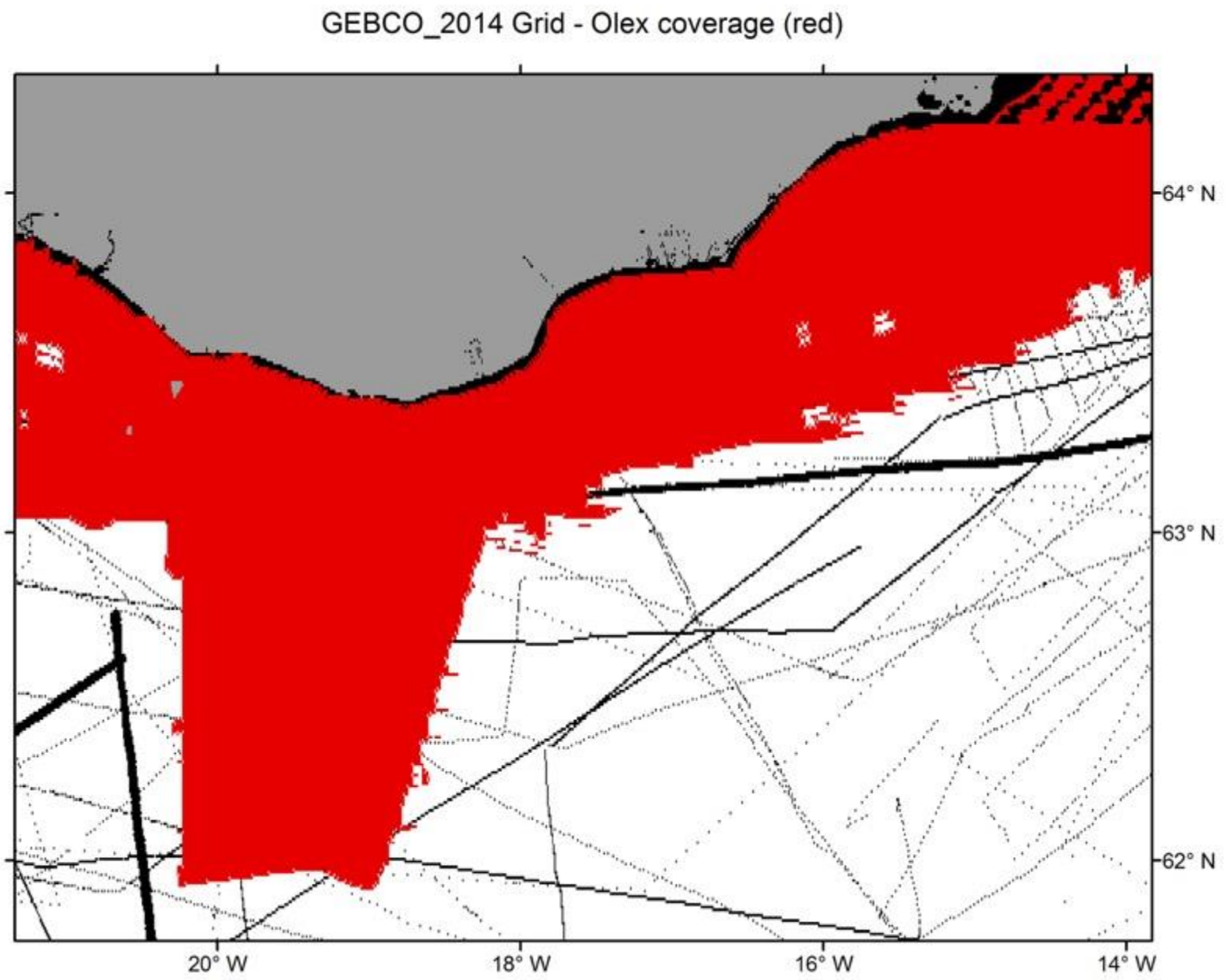
Depth contours
1
2
5
10
20
50
100
CPU 51°C
Olex

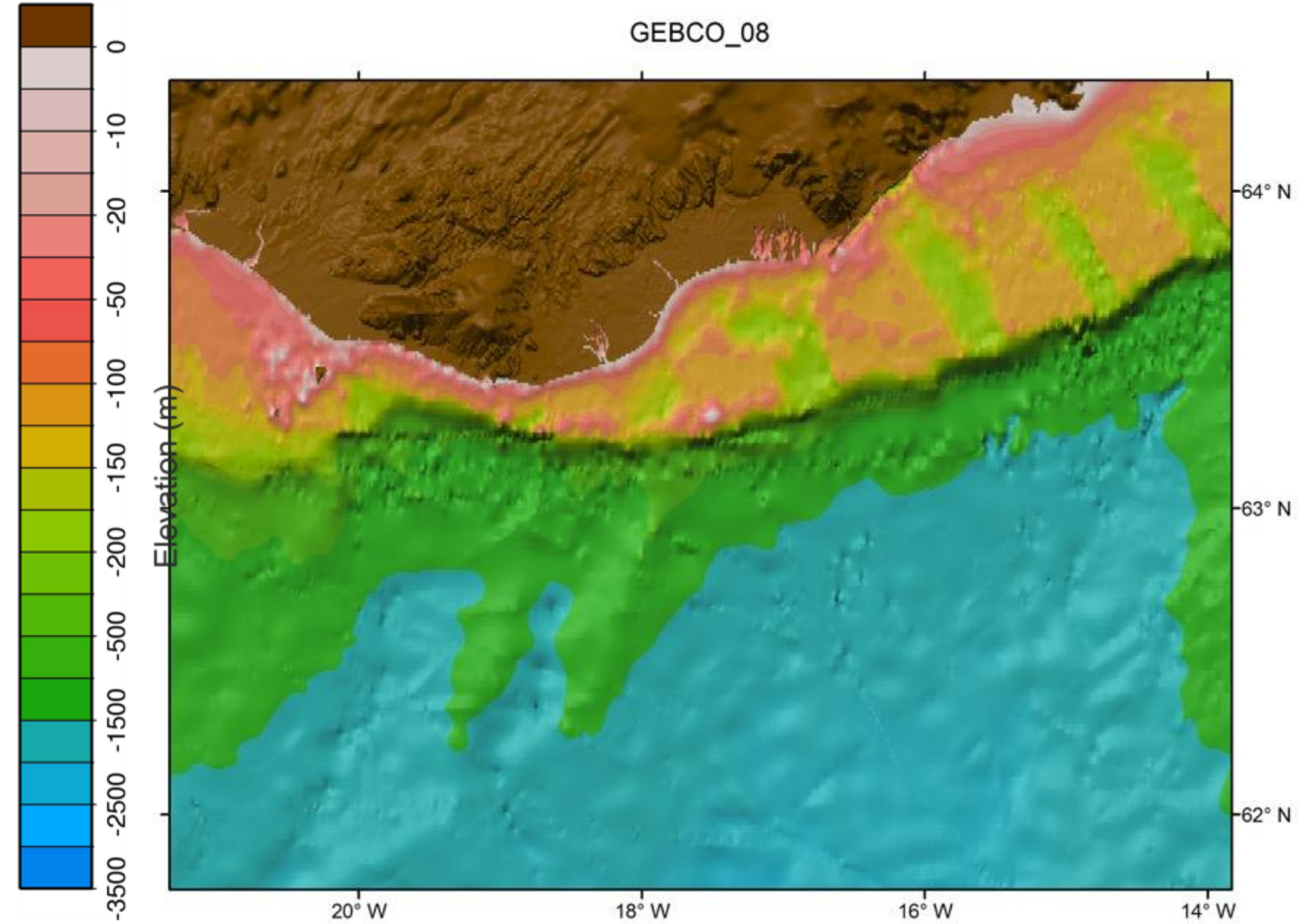


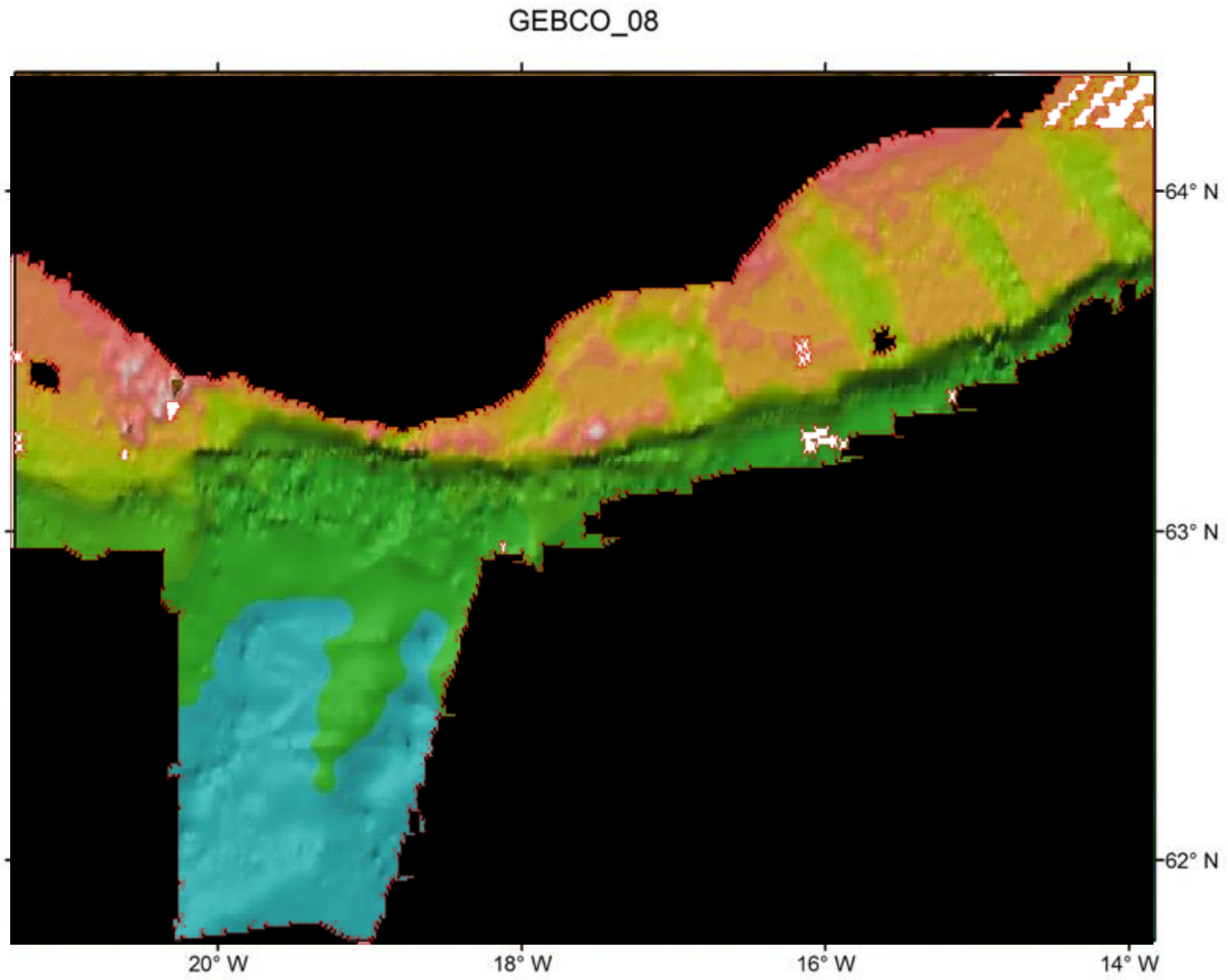


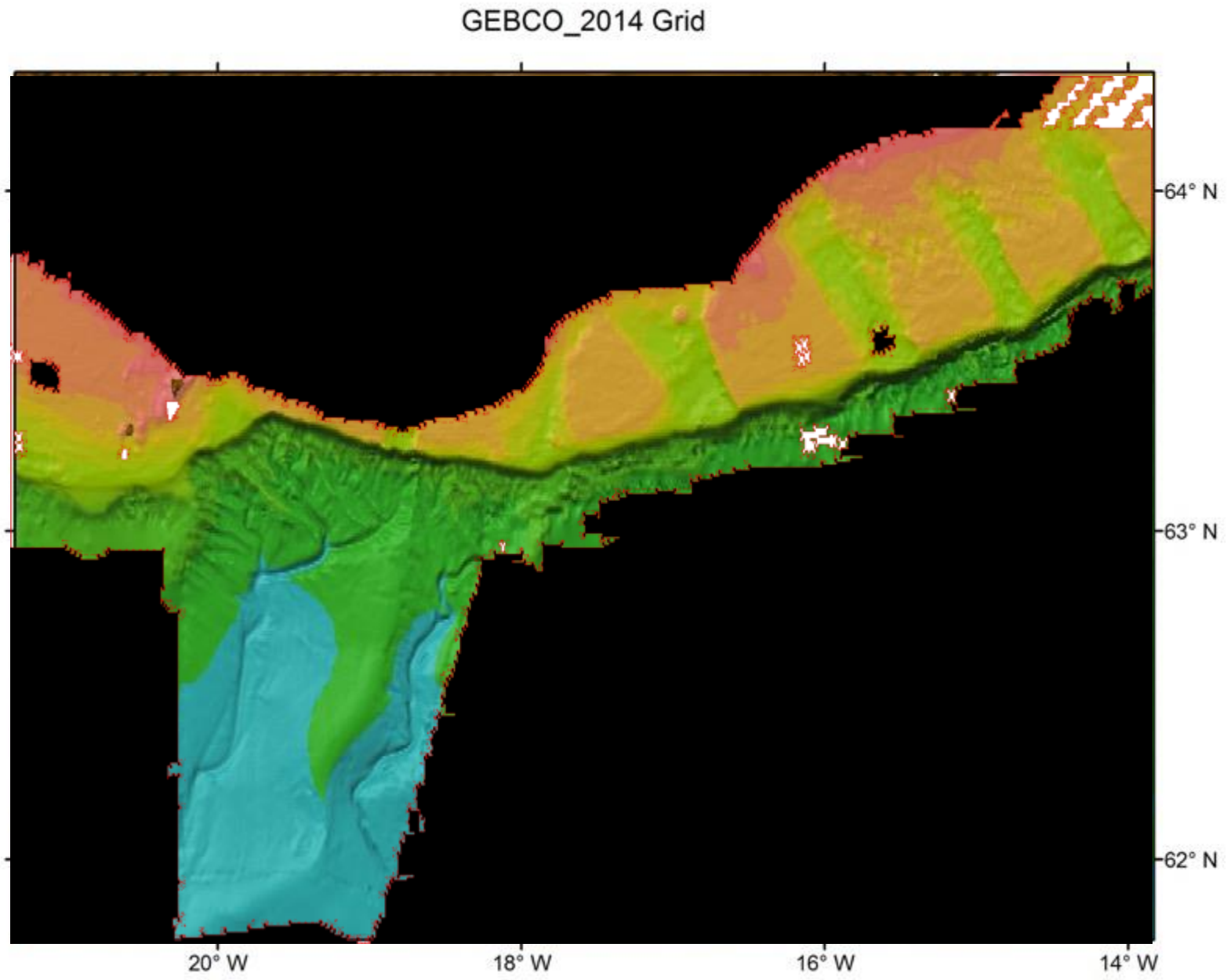
Coverage of Olex data (red) included in the GEBCO_2014 Grid in the North Atlantic Ocean region

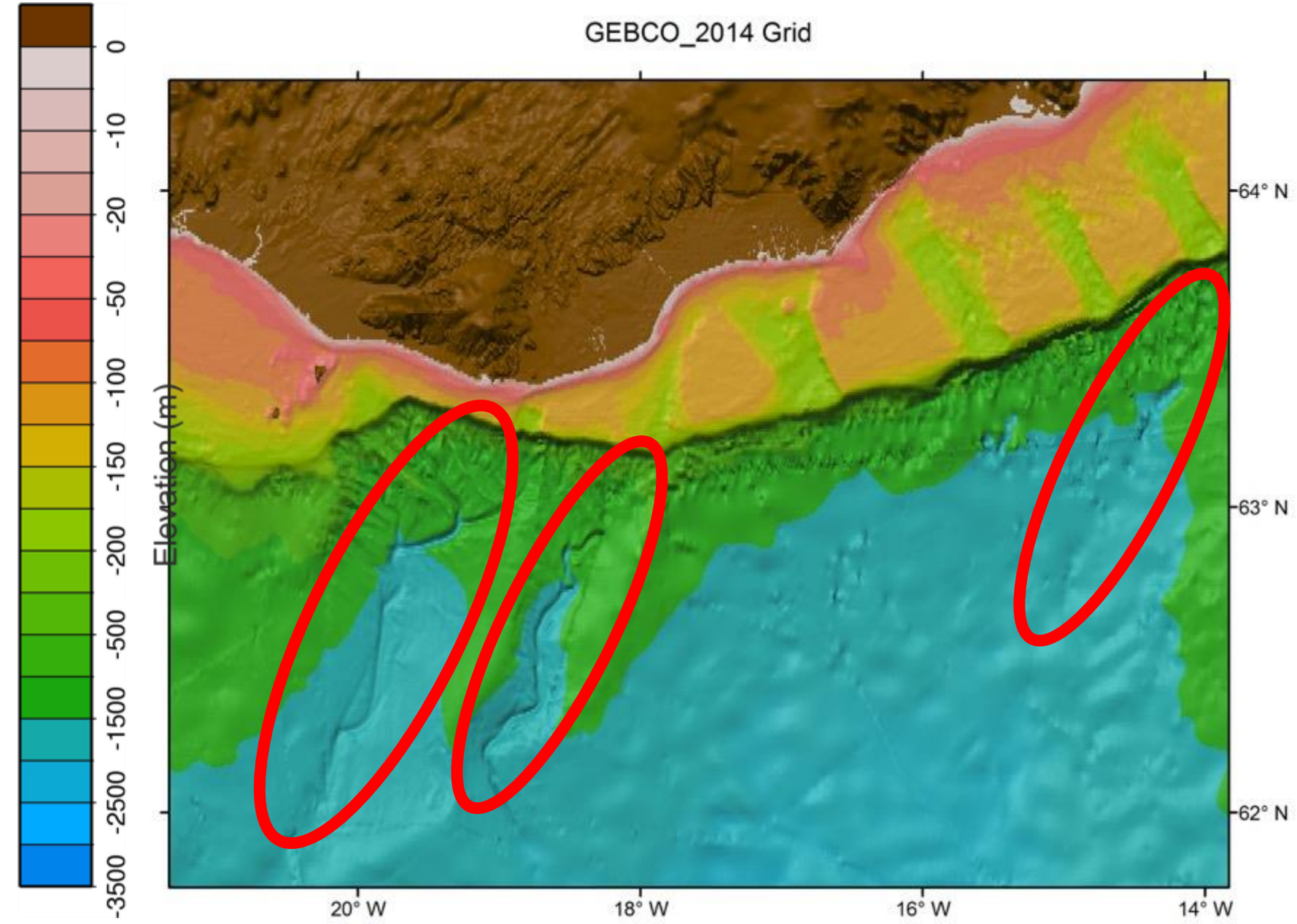


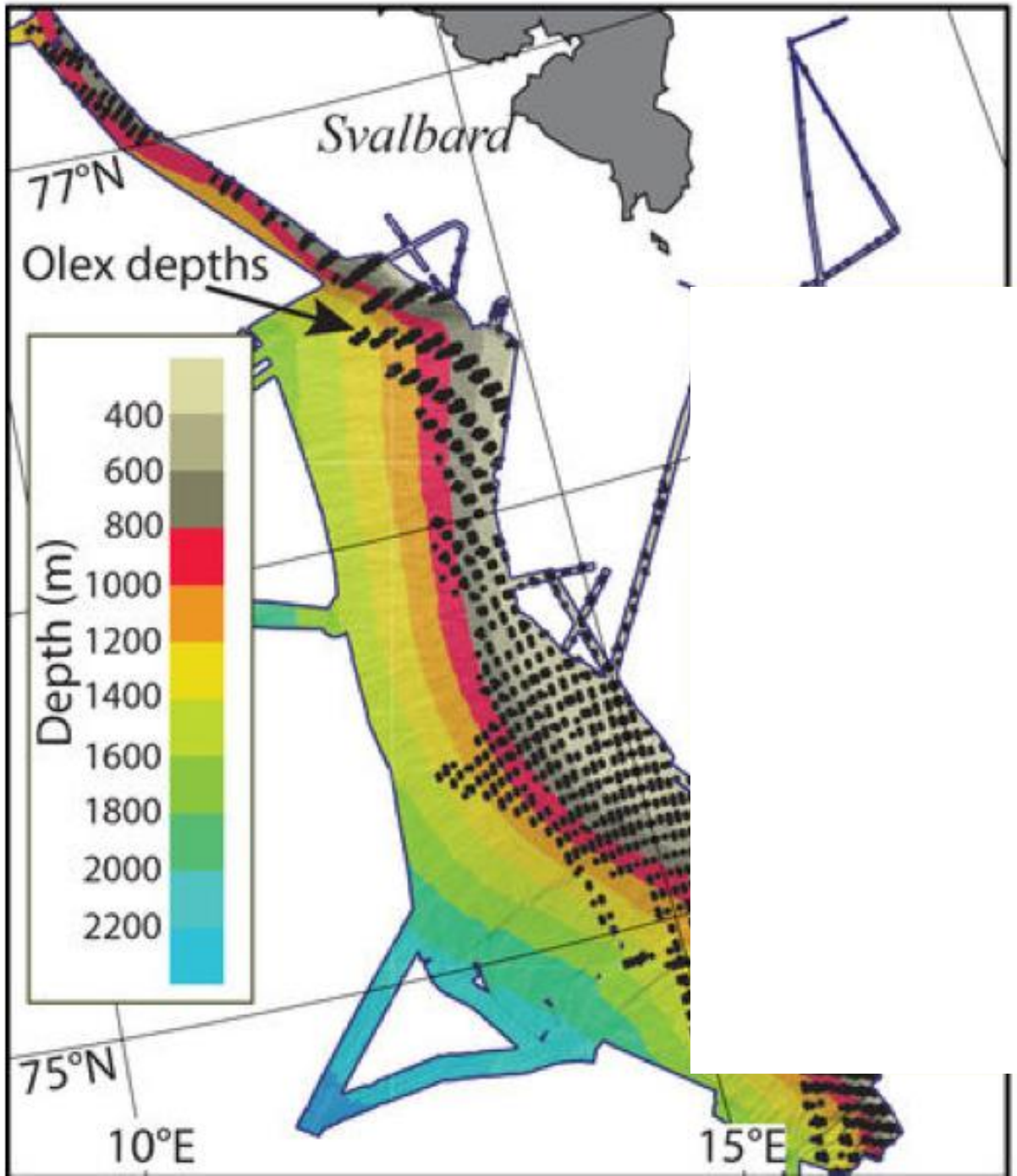

GEBCO_2014 Grid - Olex coverage (red)
64° N
63° N
62° N
20° W
18° W
16° W
14° W


GEBCO_08
Elevation (m)
0
-10
-20
-50
-100
-150
-200
-500
-1500
-2500
-3500
64° N
63° N
62° N
20° W
18° W
16° W
14° W


GEBCO_08
64° N
63° N
62° N
20° W
18° W
16° W
14° W


GEBCO_2014 Grid
64° N
63° N
62° N
20° W
18° W
16° W
14° W


GEBCO_2014 Grid
Elevation (m)
0
-10
-20
-50
-100
-150
-200
-500
-1500
-2500
-3500
64° N
63° N
62° N
20° W
18° W
16° W
14° W


Svalbard
77°N
Olex depths
Depth (m)
400
600
800
1000
1200
1400
1600
1800
2000
2200
75°N
10°E
15°E

CSB Partners

- Cruise Ships
- Yachts
- Liners
- Tankers
- Fishery vessels

UNCLOS related issue

Article 246
Marine scientific research in the exclusive economic zone and on the continental shelf

1. Coastal States, in the exercise of their jurisdiction, have the right to regulate, authorize and conduct marine scientific research in their exclusive economic zone and on their continental shelf in accordance with the relevant provisions of this Convention.
2. Marine scientific research in the exclusive economic zone and on the continental shelf shall be conducted with the consent of the coastal State.

How to increase data

- Dig up existing data
- Create new data flow, such as;
  - crowd sourced bathymetry (CSB)
  - Data harvesting from ENC
  - Expansion of GEBCO family
- Include data from new survey technologies, such as;
  - Satellite-imagery derived bathymetry (SDB),
  - lidars,
  - AUVs, ROVs, gliders, data buoys,
  - ultra-narrow beam echo sounder from a barge

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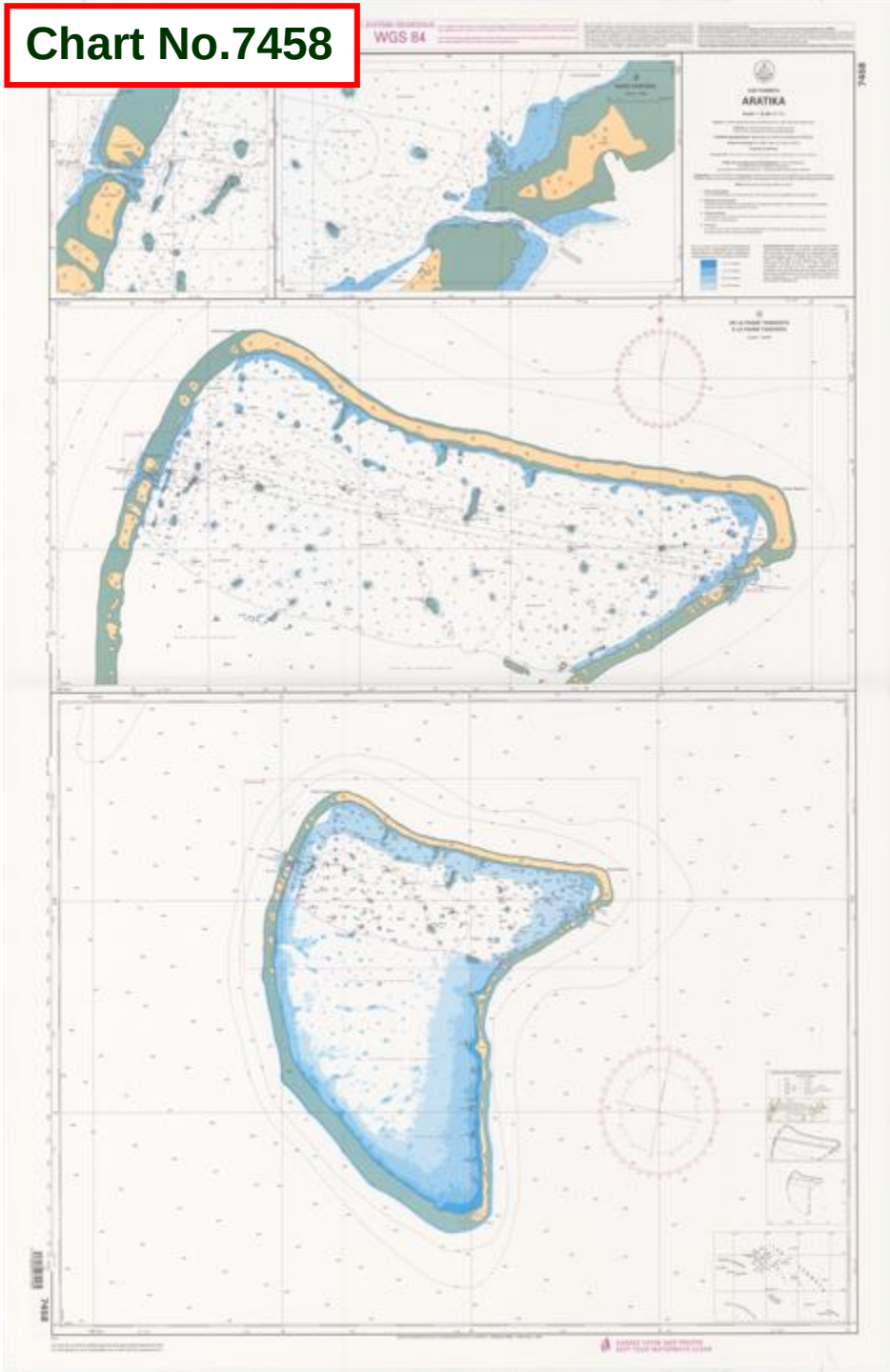
Navigational chart by SHOM

- French Polynecian Aratica



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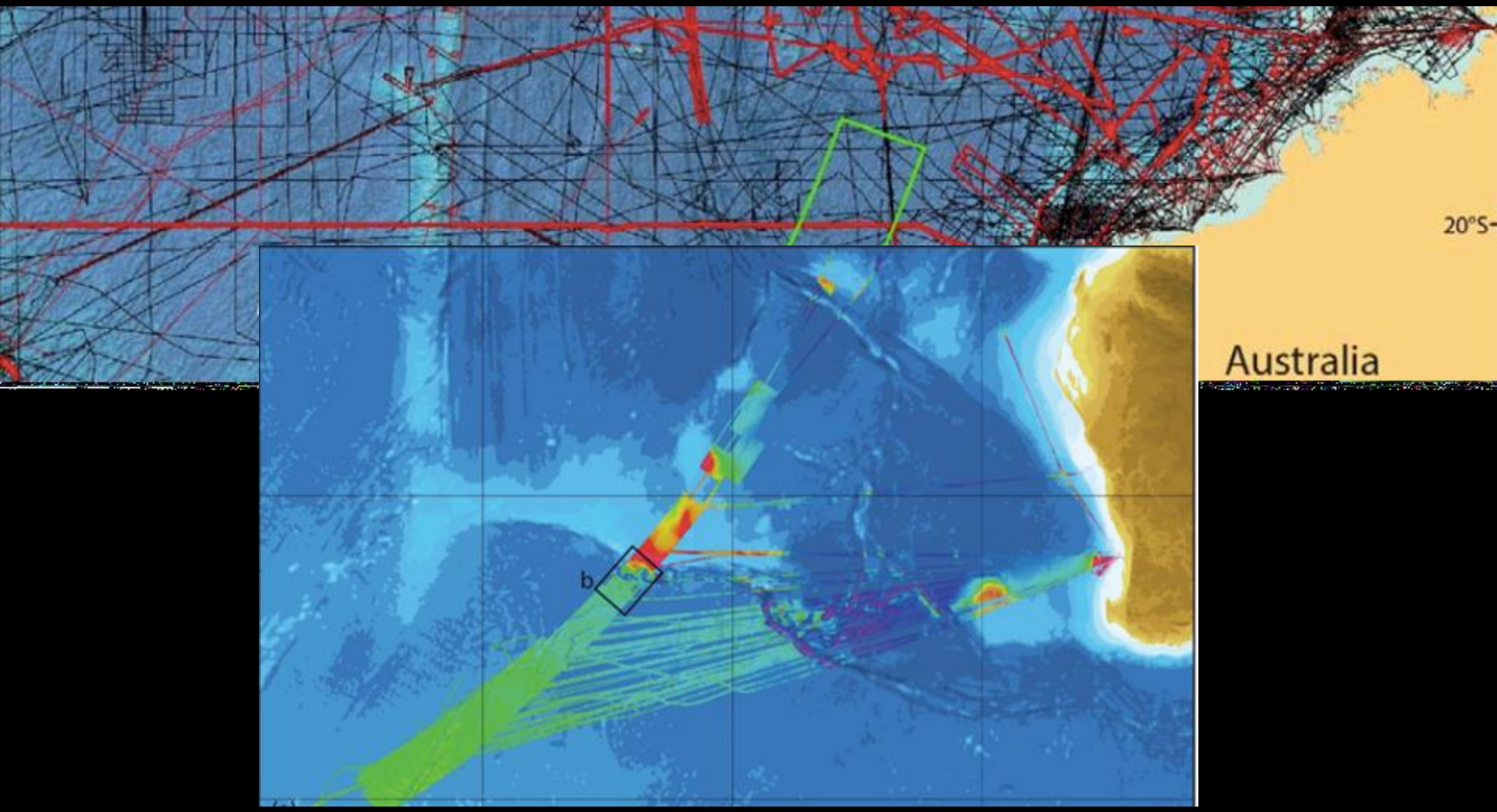
20°S
Australia
b

How to increase data

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  - ultra-narrow beam echo sounder from a barge

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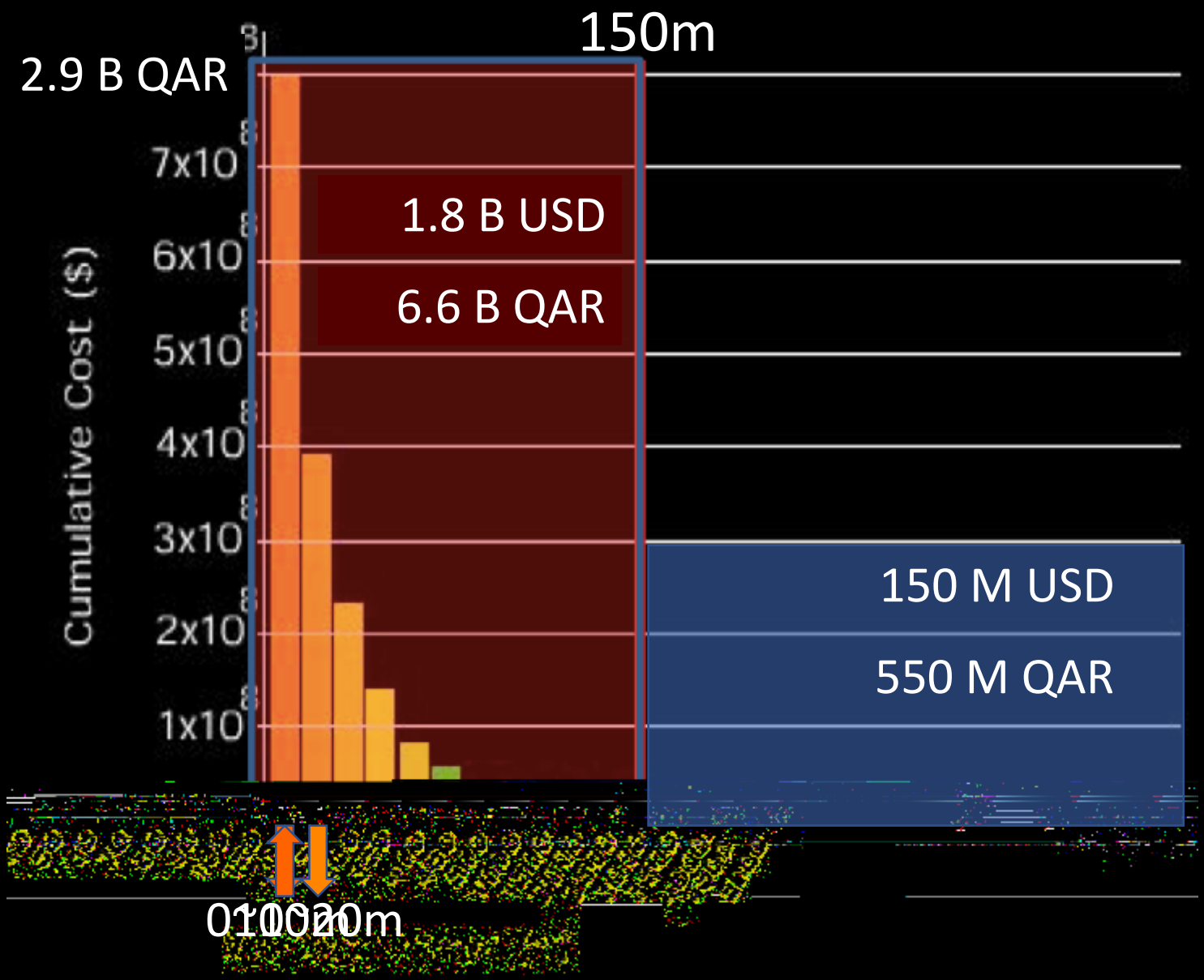
If resources allow

- The dream is survey quality 100% coverage multi-beam echo sounding.
- How much would it cost, and how many years??

MBES survey shallower than 150 meters in US.

Cost of MBES Survey vs Depth
A US case



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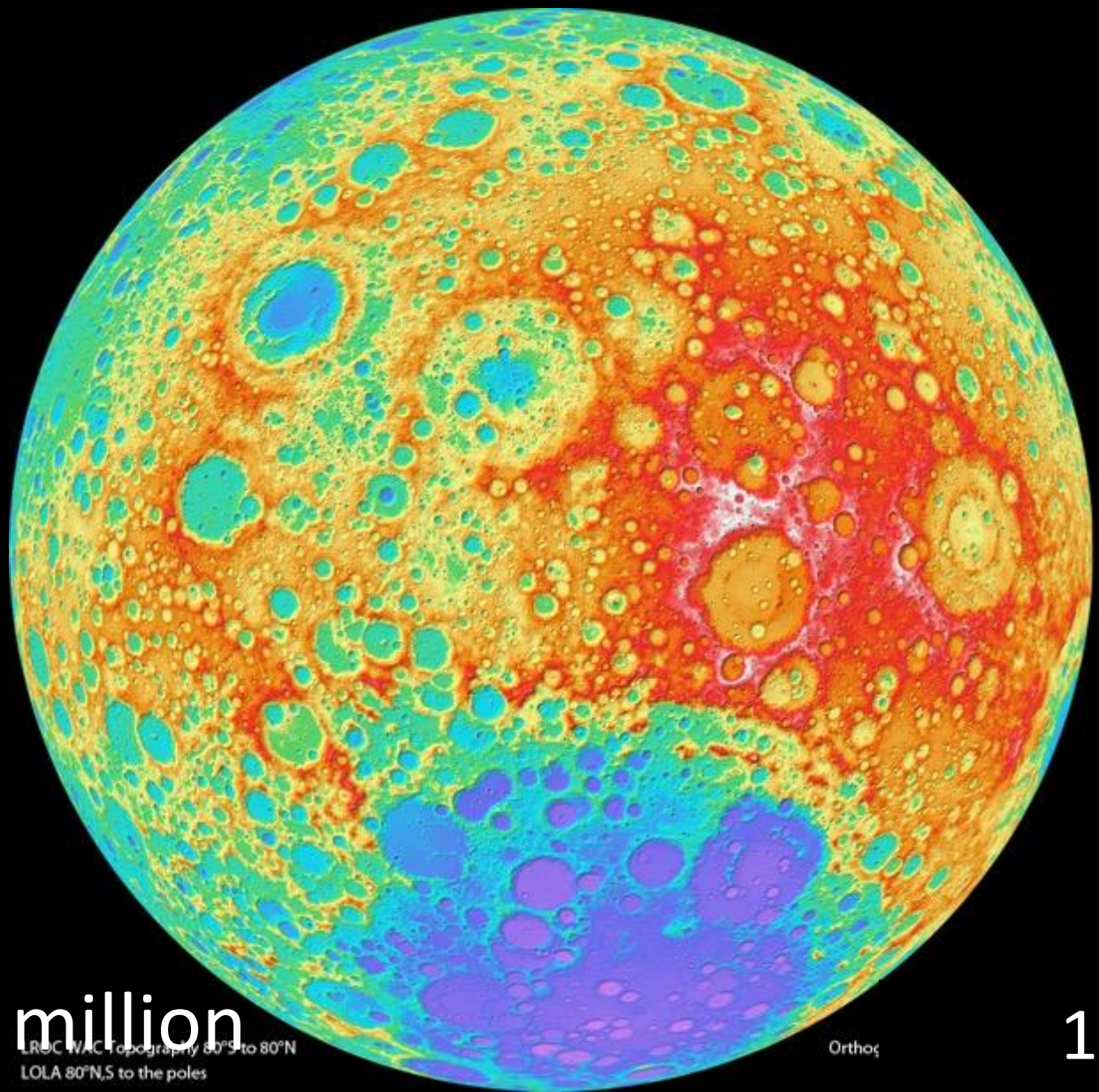
Moon



US$ 600 million

100m grid

Mars

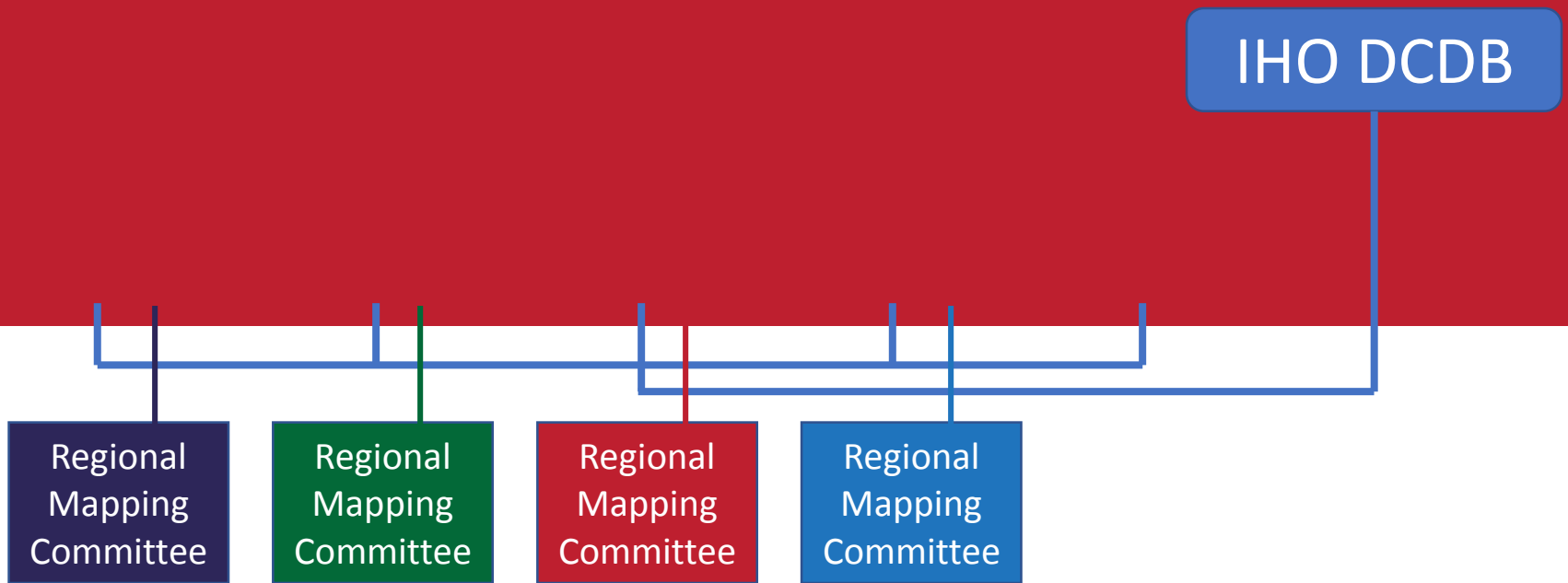
火星の地形

1m grid

Coverage of Hydrographic Survey (0-200m)

Areas

SW Pacific	> 95%
Polar Regions	> 95%
Carribian	> 80%
West Africa	> 80%
Australia	~ 65%
Greece	~ 65%
USA	~ 40%
UK	~ 30%
France	~ 19%


IHO DCDB
Regional Mapping Committee
Regional Mapping Committee
Regional Mapping Committee
Regional Mapping Committee

RDACC and GDACC

- **RDACC (Regional Data Accumulation and Coordination Center)**
- North Pacific and Arctic Region
  - Stockholm Univ. （SU） Sweden
  - Univ. New Hampshire （UNH） USA
- South and West Pacific Region
  - National Inst. Water and Air （NIWA） New Zealand
- Atlantic and Indian Ocean Region
  - Lamont Doherty Earth Observatory （LDEO） USA
- Sothern Ocean Region
  - Alfred Wegener Polar Ocean Institute （AWI） Germany
- **GDACC (Global Data Accumulation and Coordination Center)**
  - British Oceanographic Data Centre （BODC） UK

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