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UNIVERSITY OF LISBON
INTERDISCIPLINARY STUDIES
ON SUSTAINABLE ENVIRONMENT AND SEAS

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UNIVERSITY OF LISBON
INTERDISCIPLINARY STUDIES
ON SUSTAINABLE ENVIRONMENT AND SEAS

MARINE RESOURCES

(an overview)

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Overview

oceans as heterogeneous
1 and dynamic systems

2 food resources

3 mineral resources

4 energy resources

5 hydric resources

6 marine transport

ecosystem
7 services

8 ocean monitoring

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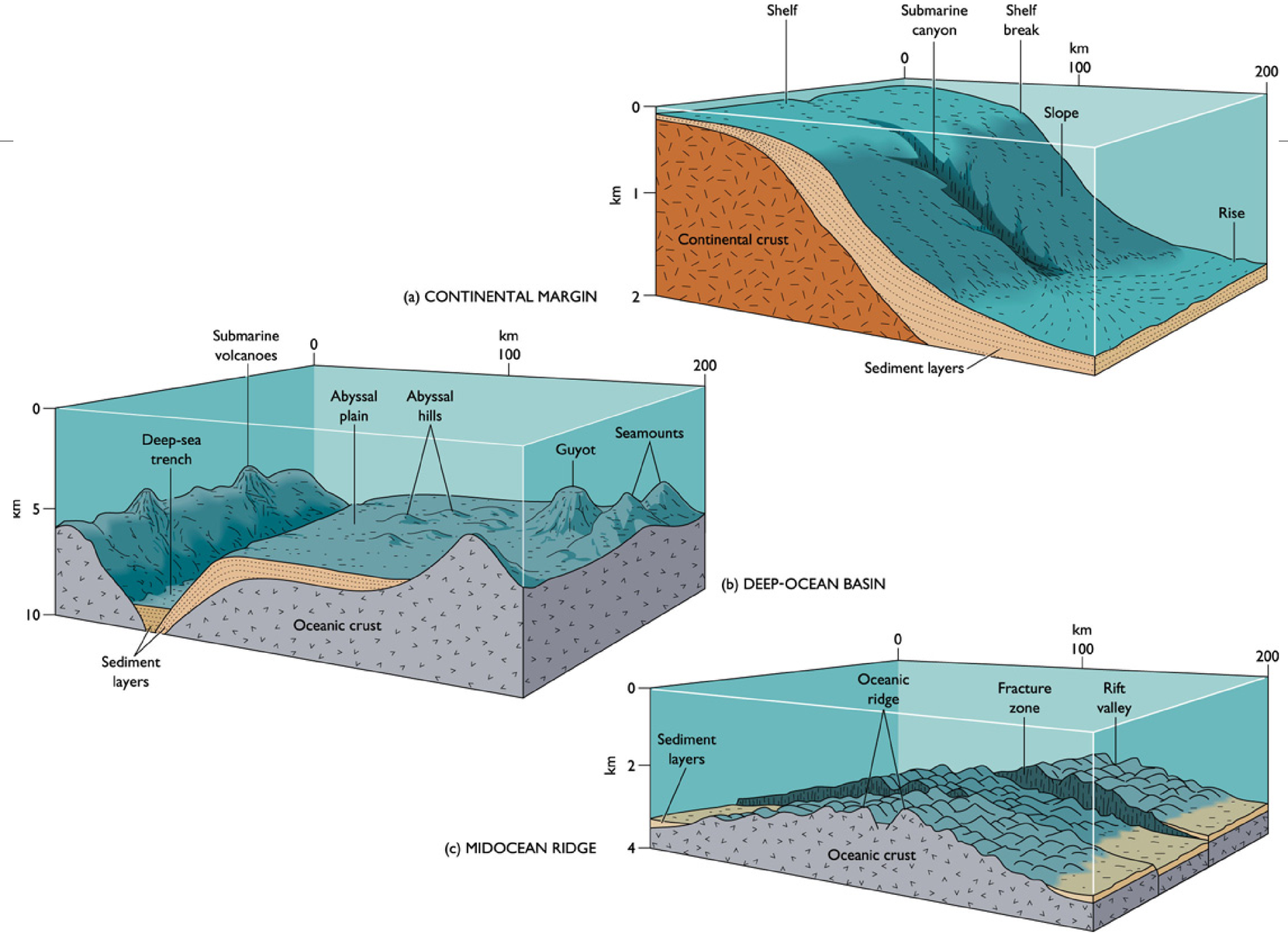
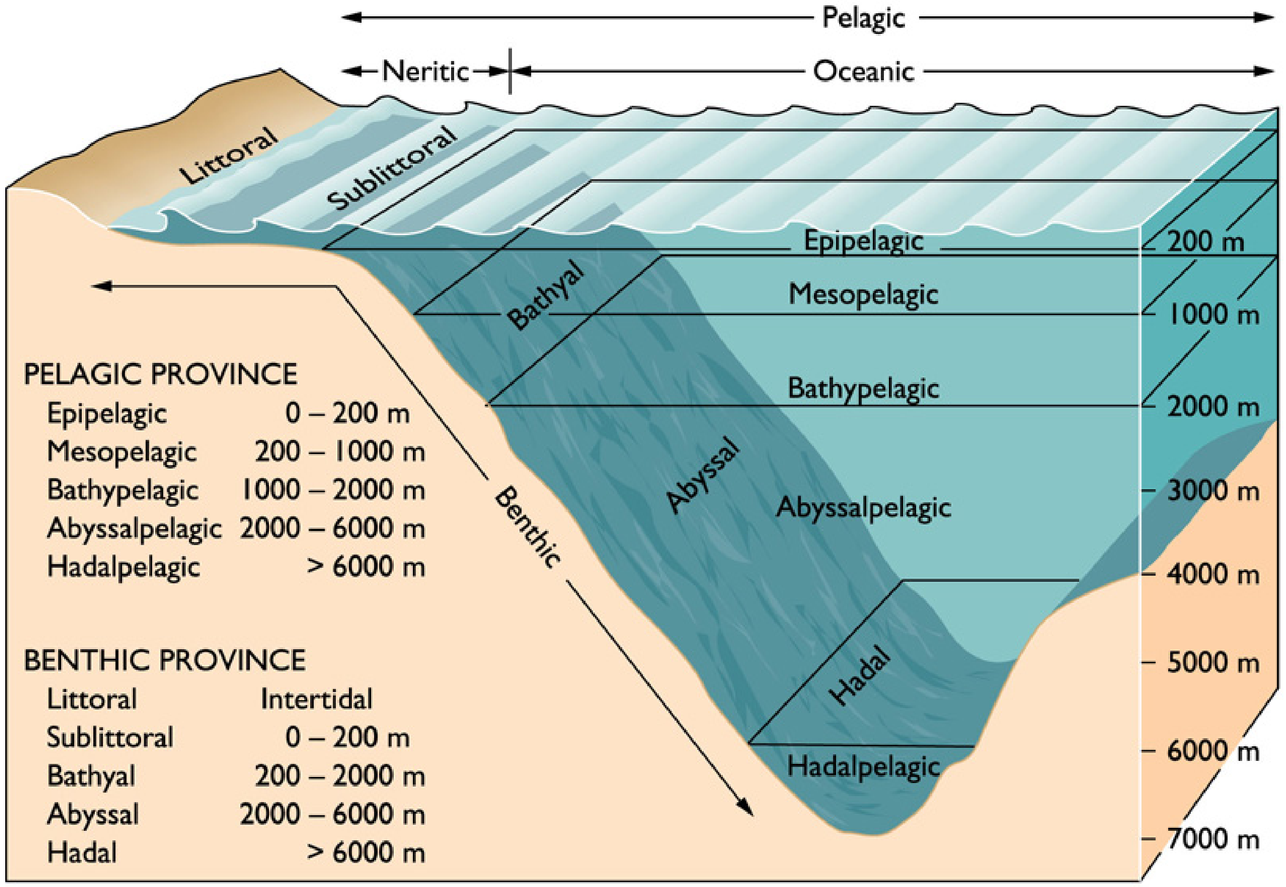
Marine Resources

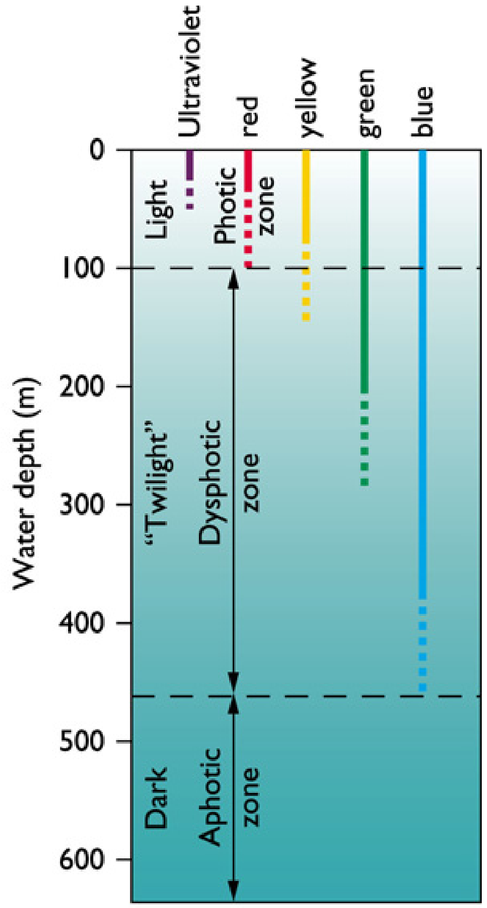
The oceans and the seas are dynamic and heterogeneous systems – marine resources are a consequence of that


Shelf
Submarine canyon
Shelf break
km
0
100
200
Slope
Rise
Continental crust
Sediment layers
(a) CONTINENTAL MARGIN
Submarine volcanoes
Abyssal plain
Abyssal hills
Deep-sea trench
Guyot
Seamounts
Oceanic crust
Sediment layers
(b) DEEP-OCEAN BASIN
Oceanic ridge
Fracture zone
Rift valley
Sediment layers
Oceanic crust
(c) MIDOCEAN RIDGE

Ocean regions and light availability



(a) BIOZONES



(b) LIGHT ZONES

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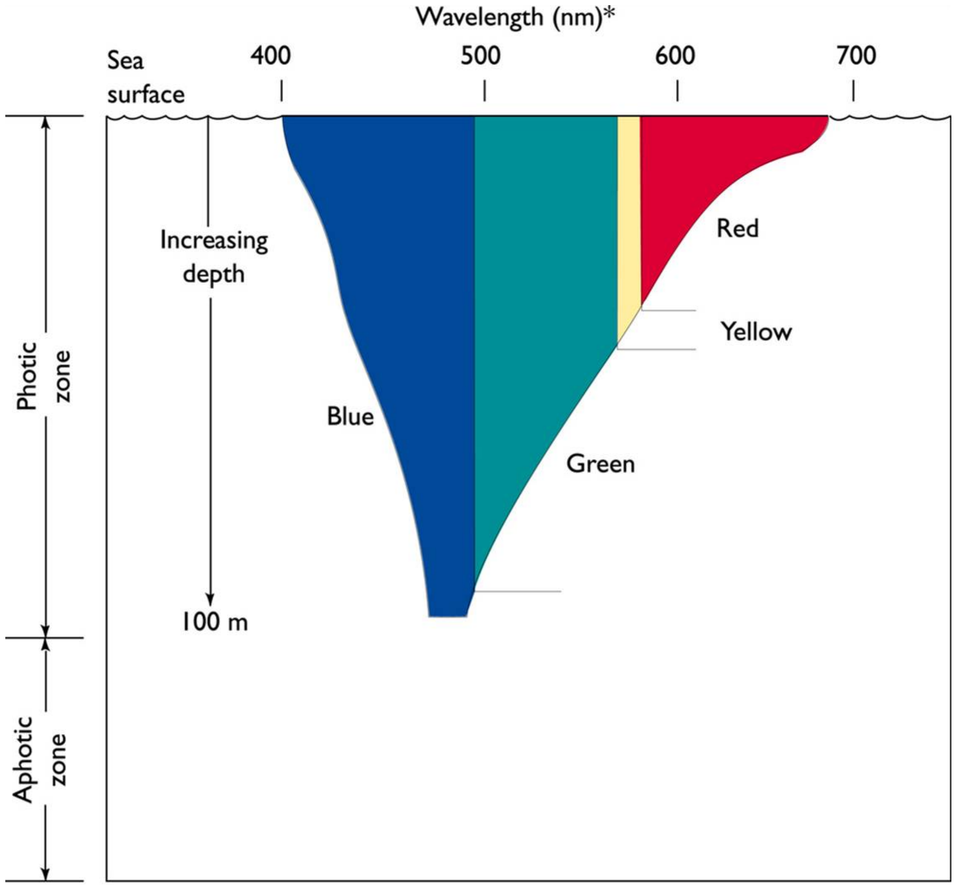
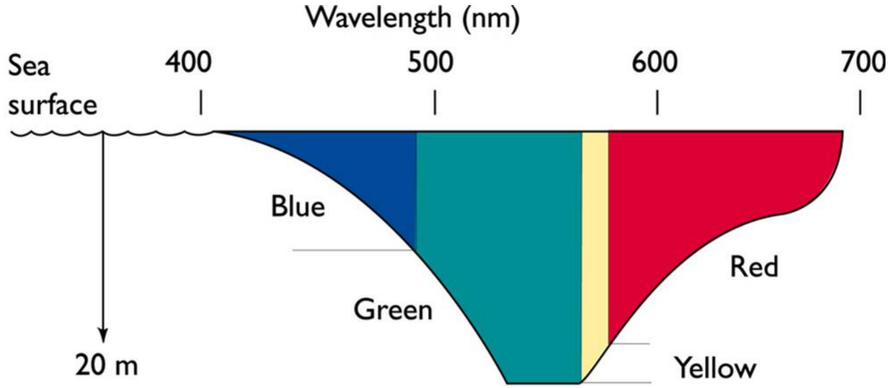
Ocean regions and light availability



* nm = nanometer (one billionth of a meter)

(a) LIGHT ABSORPTION IN THE OPEN OCEAN



(b) LIGHT ABSORPTION IN NEARSHORE WATERS

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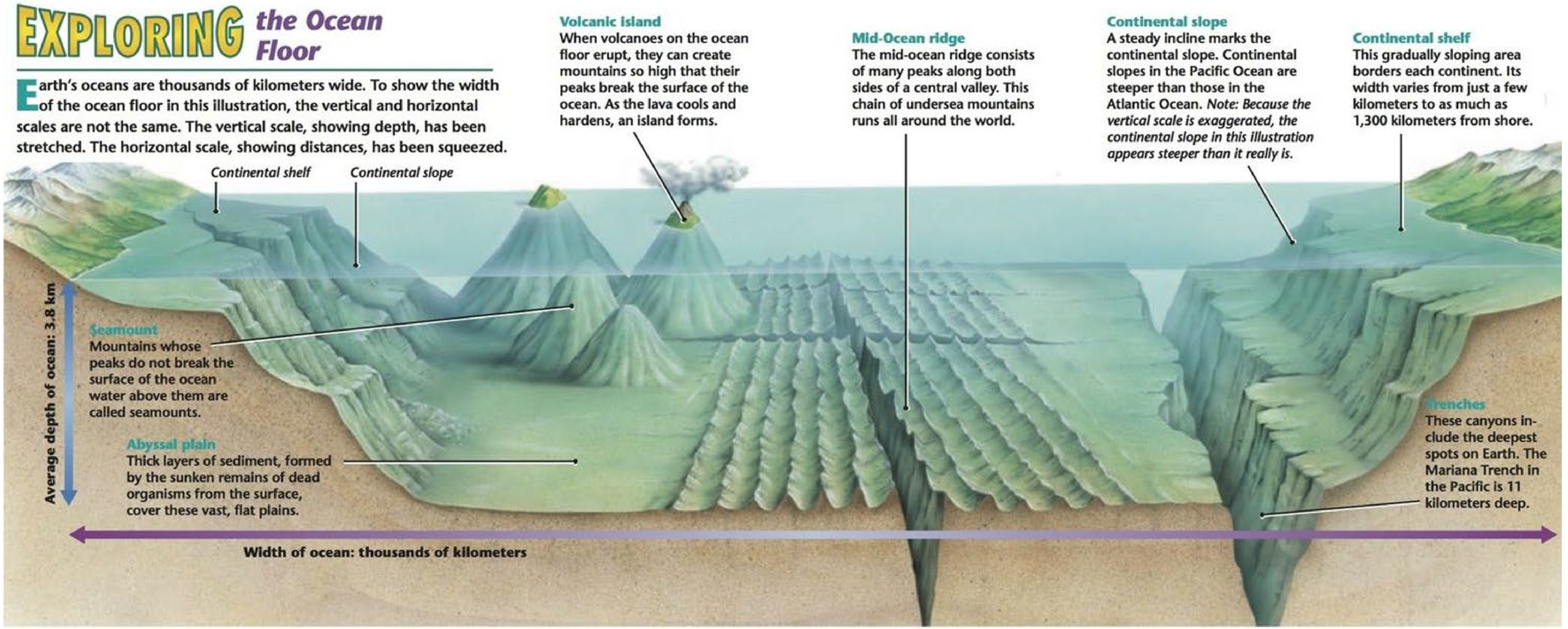
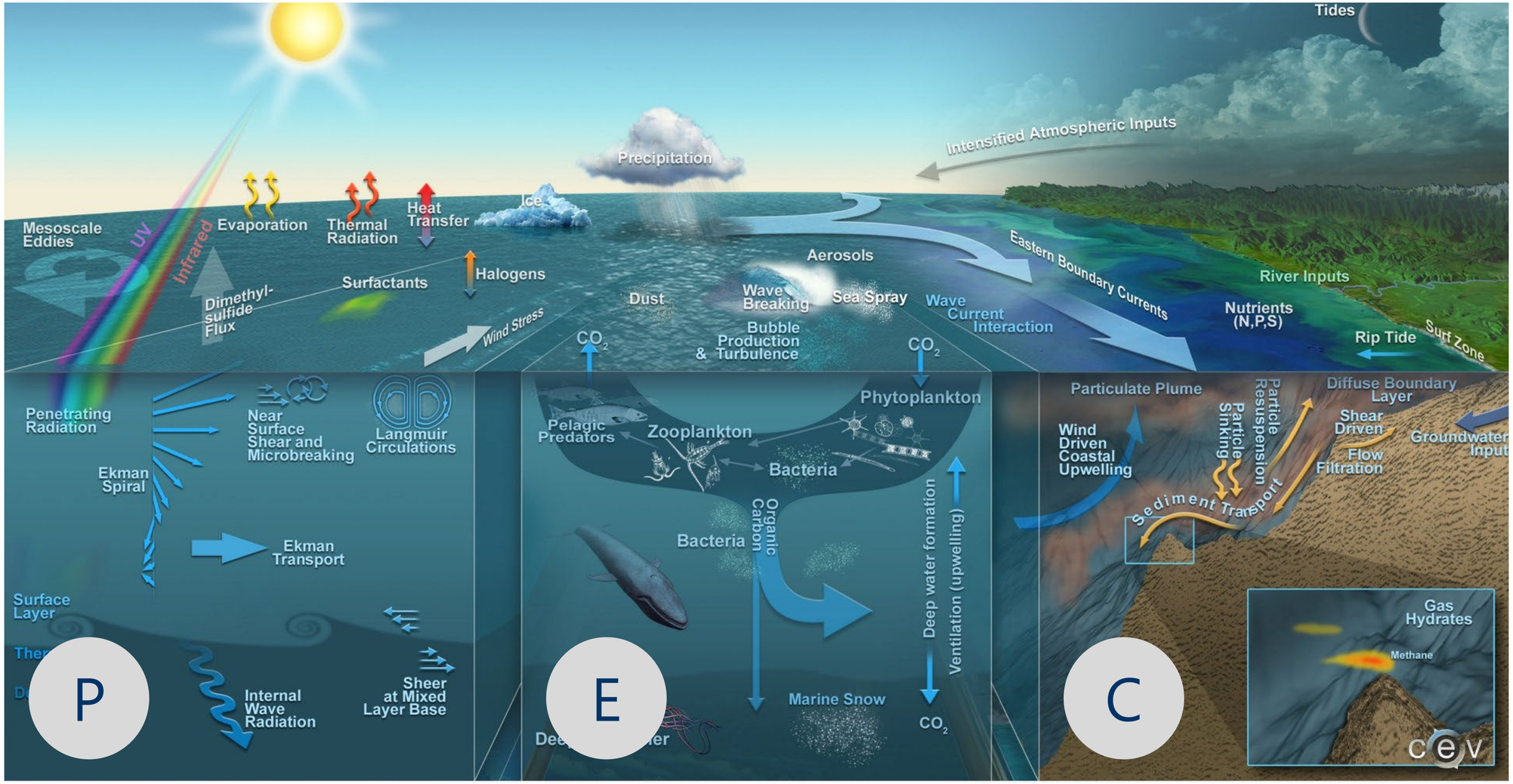
The ocean floor



Processes in the ocean



Physical

Ecological

Chemical

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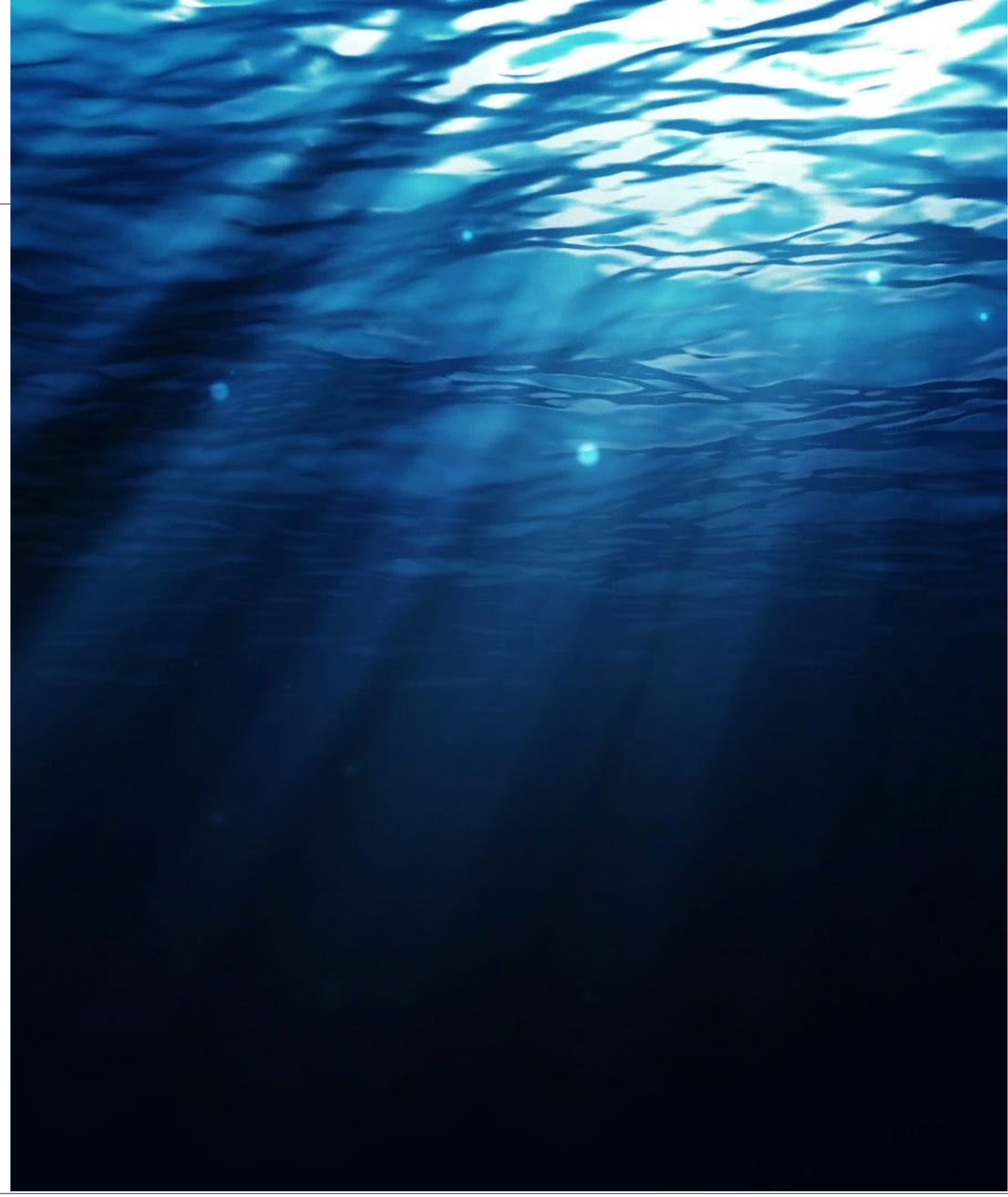
Marine systems…

- are dynamic systems shaped by an interplay of complex physical, chemical and ecological processes, occurring at different time scales
- vary significantly in space (latitude, longitude and depth) and in time (e.g., seasonal patterns)
- can only be managed and their resources harvested with intensive ocean monitoring



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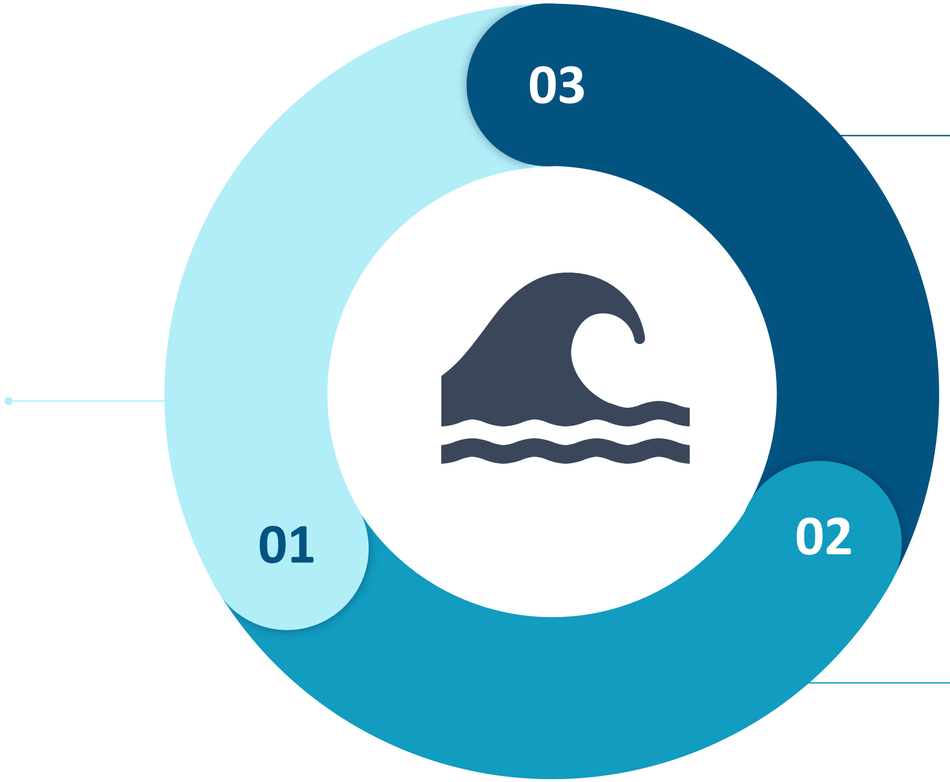
Traditional view of marine resources

Food Resources

Plants, algae and marine organism (or their derivatives) used to feed humans and animals alike



Mineral Resources

Concentrations of ore (mainly metallic) whose characteristics make its extraction technically and economically viable

Energy Resources

Any natural resources that can be used to obtain energy (both renewable and non-renewable)

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Current view of marine resources

Food

Plants, algae and marine organism (or their derivatives) used to feed humans and animals alike

Minerals

Concentrations of ore (mainly metallic) whose characteristics make its extraction technically and economically viable

Energy

Any natural resources that can be used to obtain energy (both renewable and non-renewable)

Fresh water

Fresh water obtained from sea water through the desalination process

Transportation

Large-scale use of oceans and seas to transport goods and people

Ecosystem

Environmental (ecosystem) services provided by nature and indispensable to man

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Food resources

the seas as a source
of edible provisions

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Food resources

History

The oceans and seas are one of the main sources of food since the dawn of humanity

Production

Fishing and aquaculture produce ~140 x 10^6 ton. of plants and animals annually

Organisms

Fish, molluscs, crustaceans and algae make up most of the human food with marine origin

Health

The reputation of marine food has increased in recent years, mostly because it is assumed to be healthier than other food sources

Protein

The importance of marine food in human diet varies worldwide, but remains one of the main sources of animal protein

Aquaculture

Aquaculture has steadily gained importance as a supply of marine food (having become a high profitability business)

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Food resources

Food resources

low-cost to premium

(from a few cents to hundreds of $/kg)




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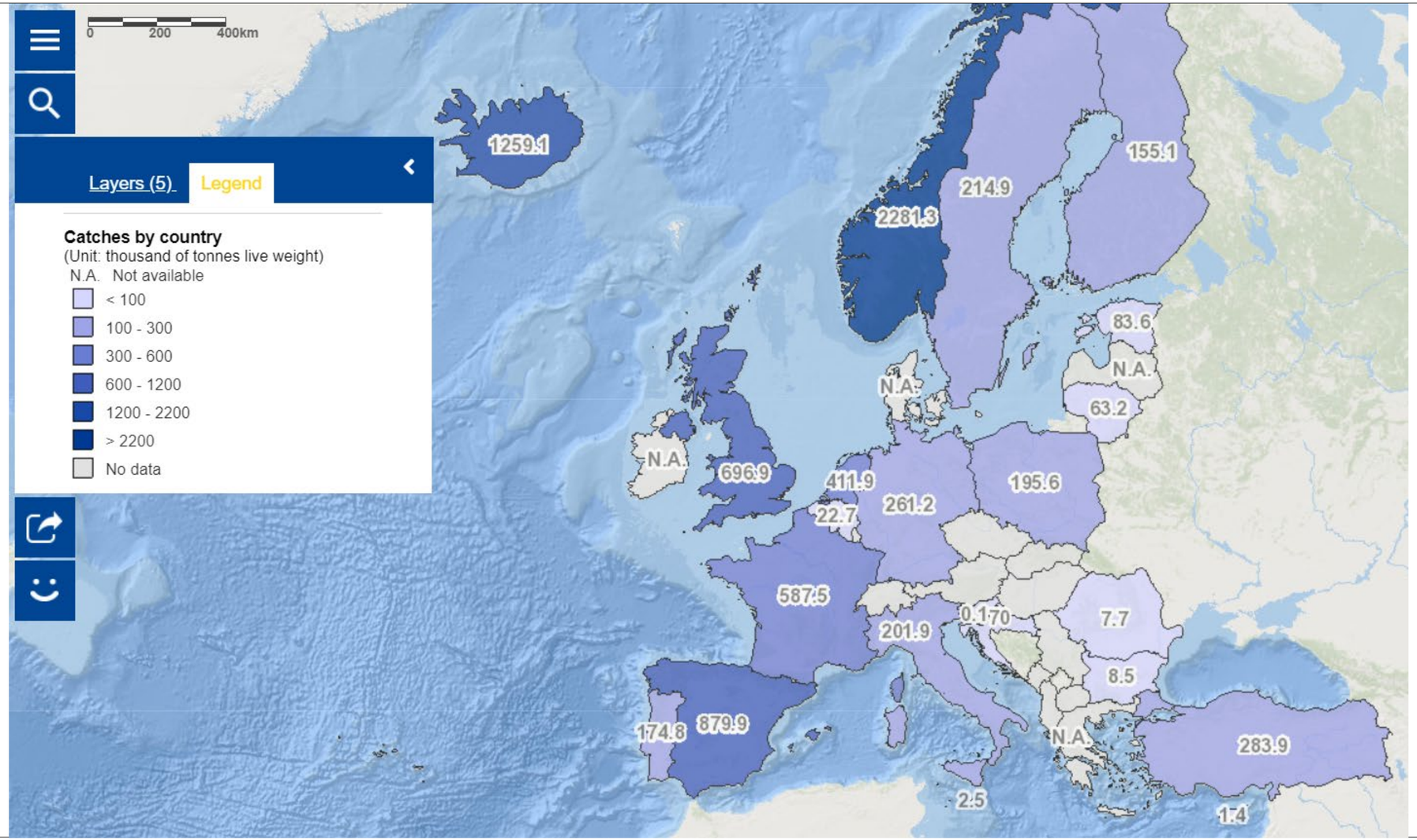
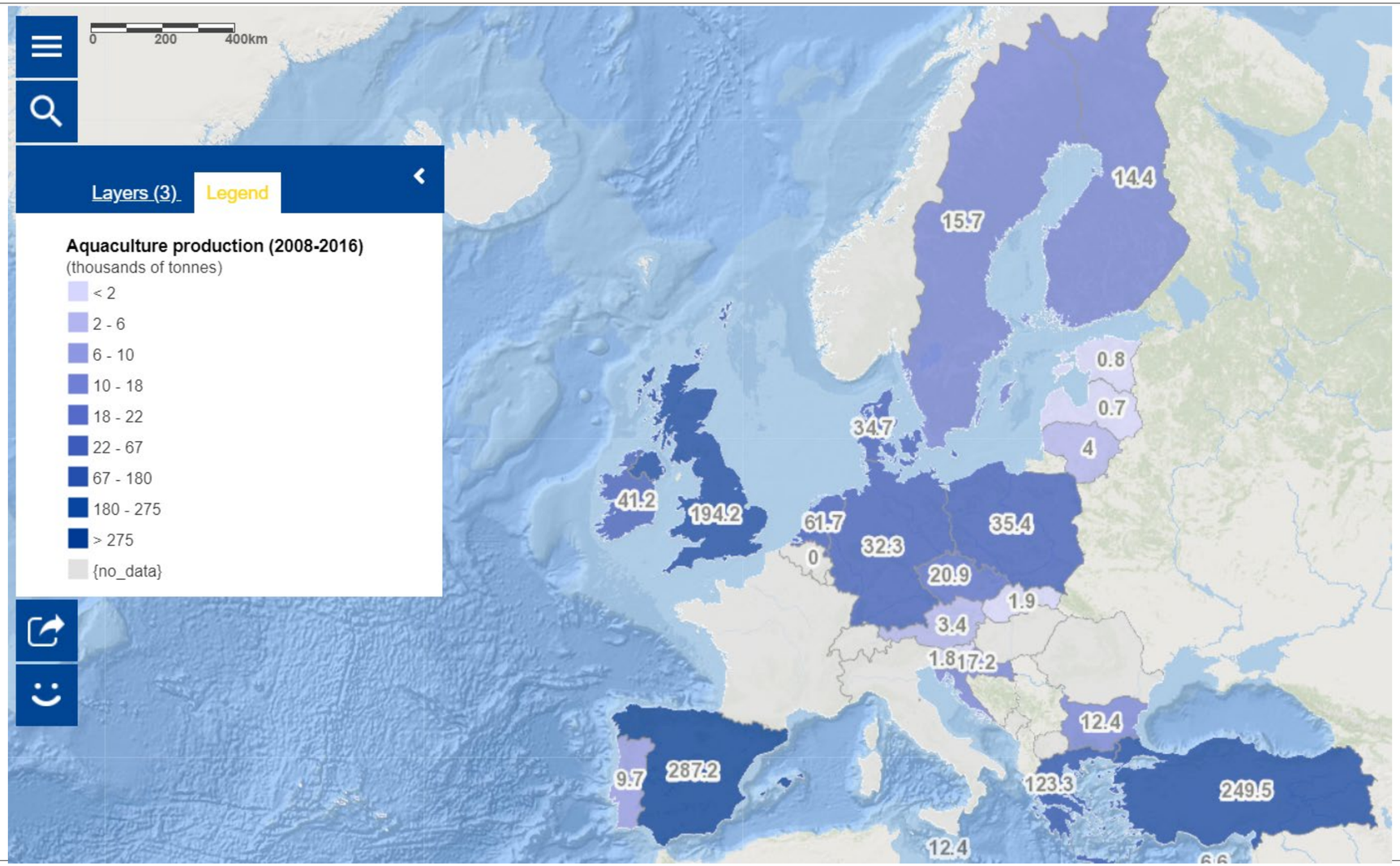
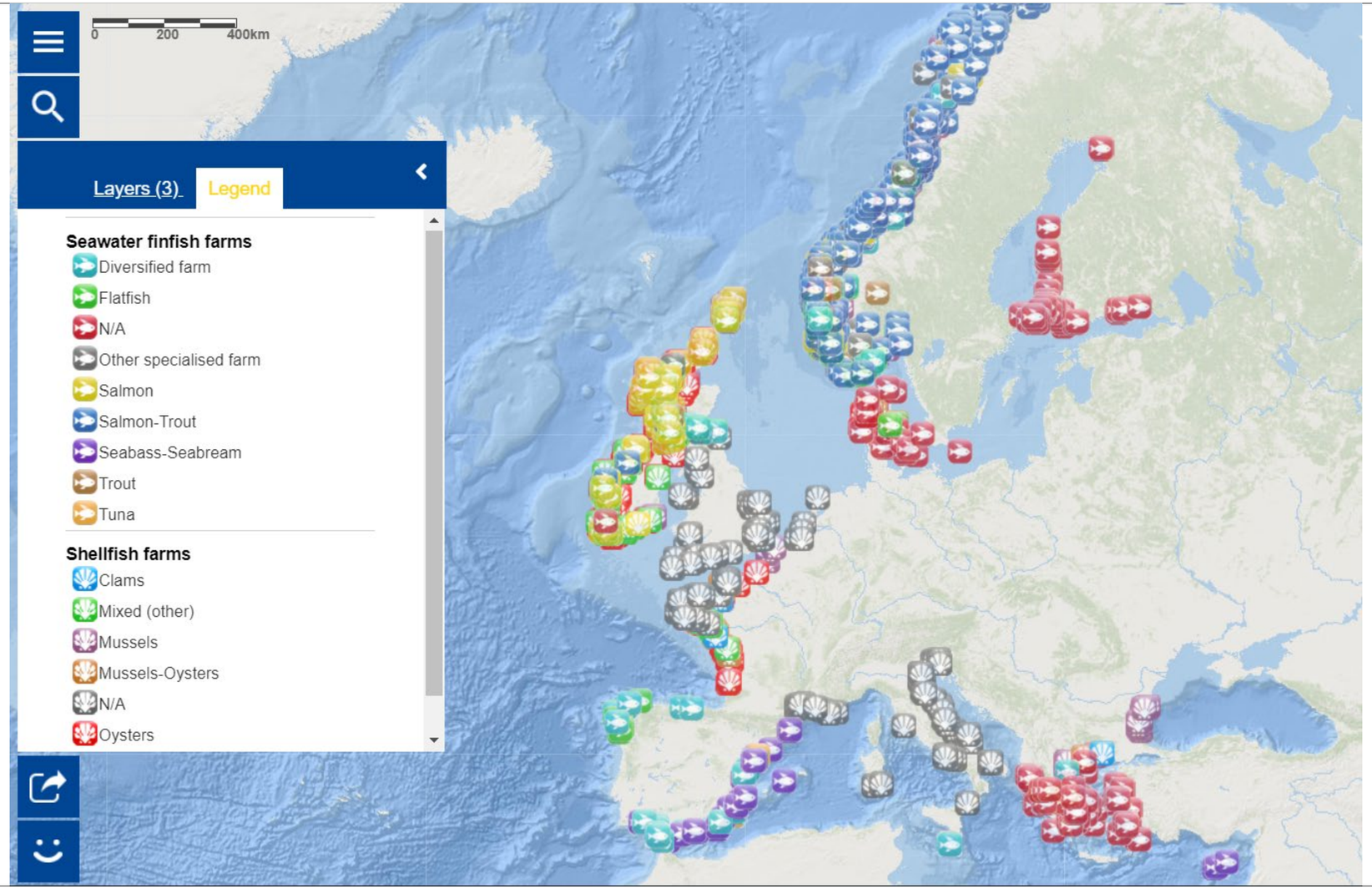
Food resources



Food resources



Food resources



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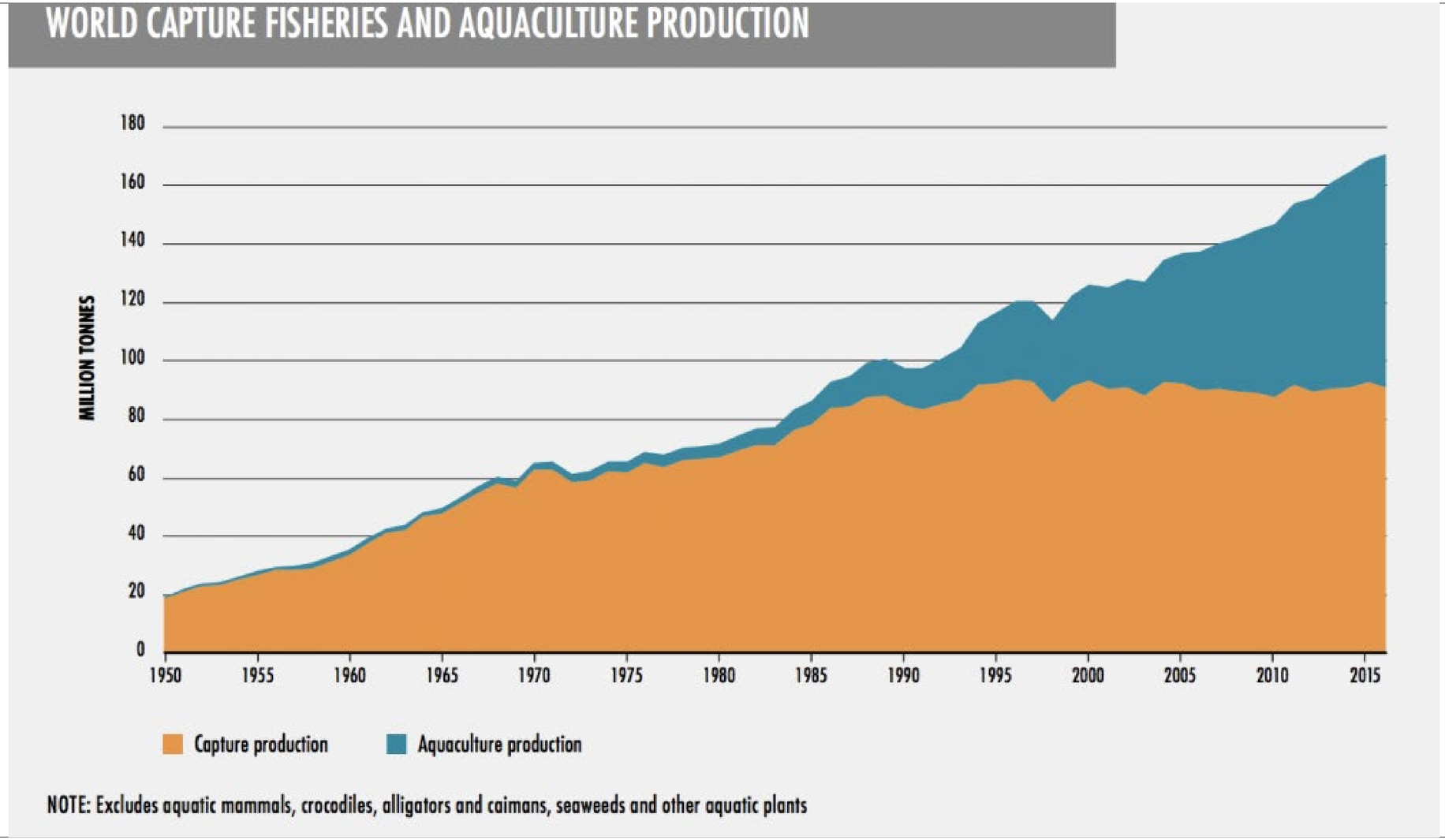
Food resources



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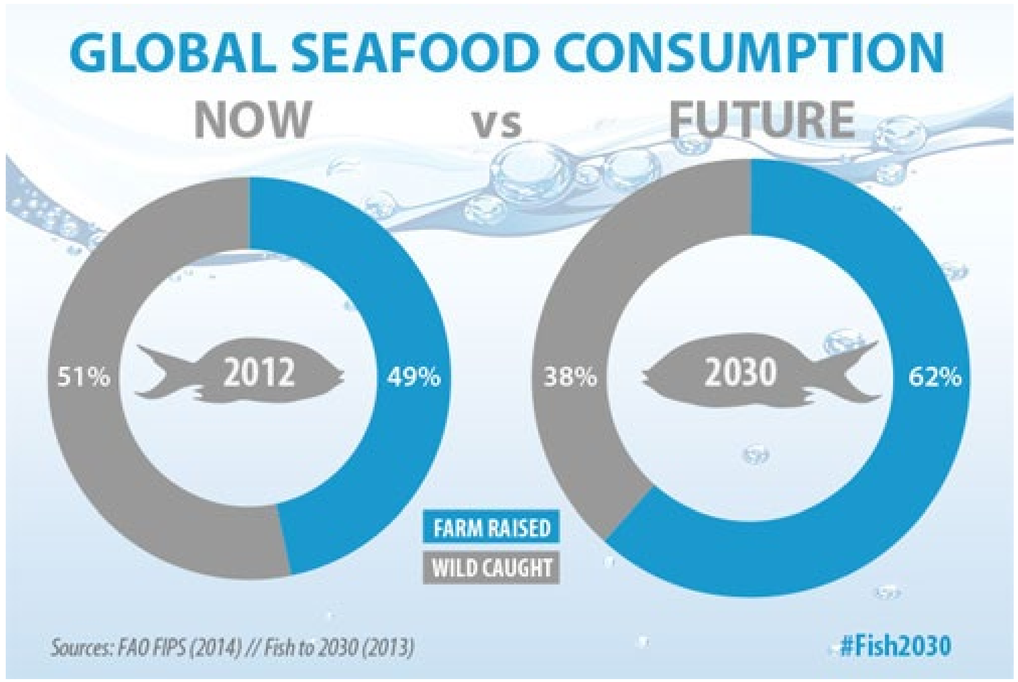
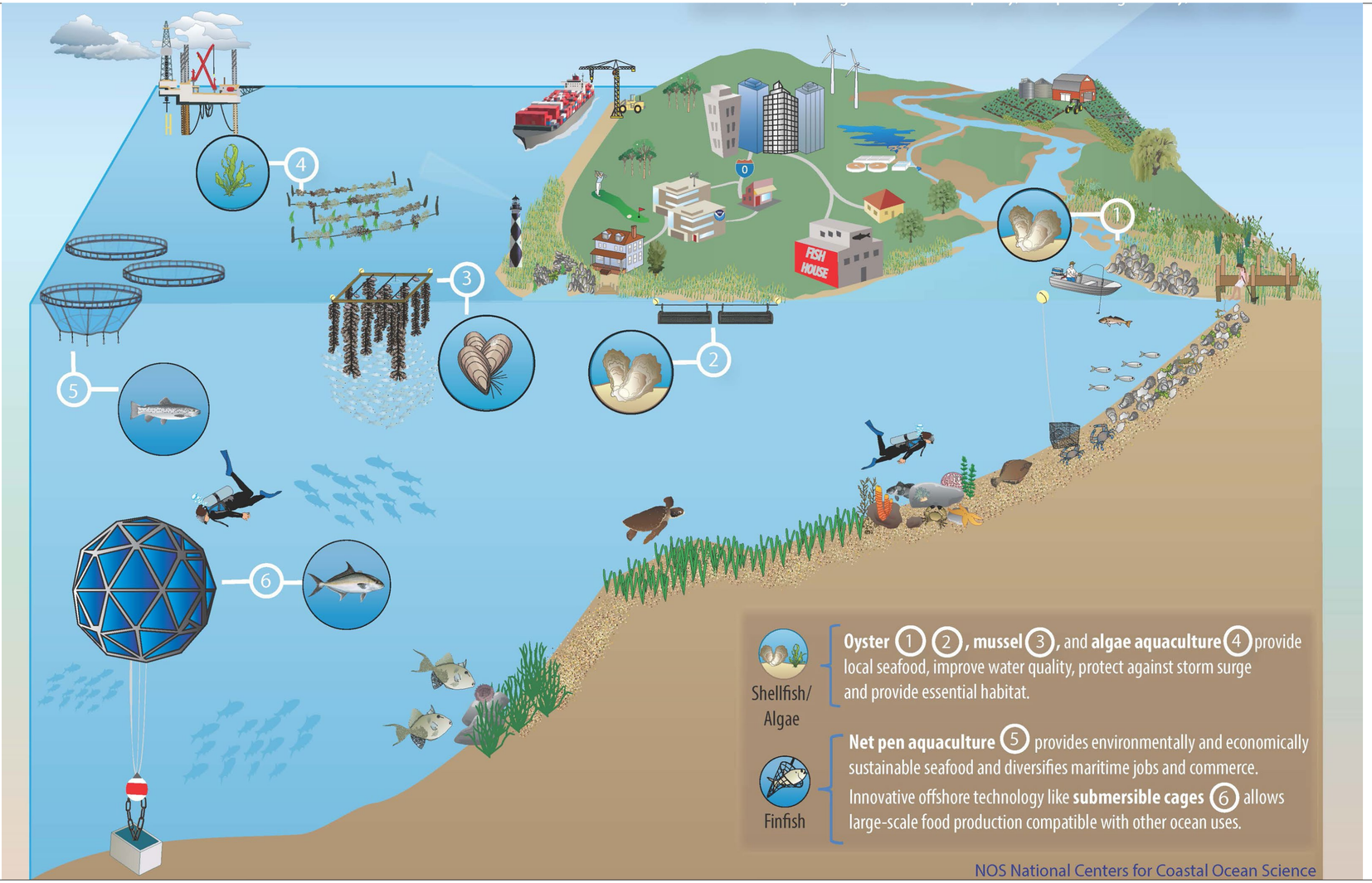


Food resources



Multiple vs. conflictive use of ocean resources

Several resources can be explored in the same areas of the oceans and seas (especially coastal areas) leading to multiple or conflictive uses

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Mineral resources

the seas as a source of raw materials

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Mineral resources

Origin

A significant variety of geological processes occur in the oceans; they are responsible for the formation and concentration of mineral resources

Deposits

The oceans are also the final repository of many eroded or dissolved materials from the earth's surface

Diversity

The oceans contains large amounts of materials that are important resources for humans (magnesium, gold, tin, etc.).

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Mineral resources

Surface deposits

Deposits found on the continental shelf, continental slope and deep-sea area

Subsurface deposits

Underground deposits (oil and natural gas); represent 90% of the mineral value currently taken from the sea

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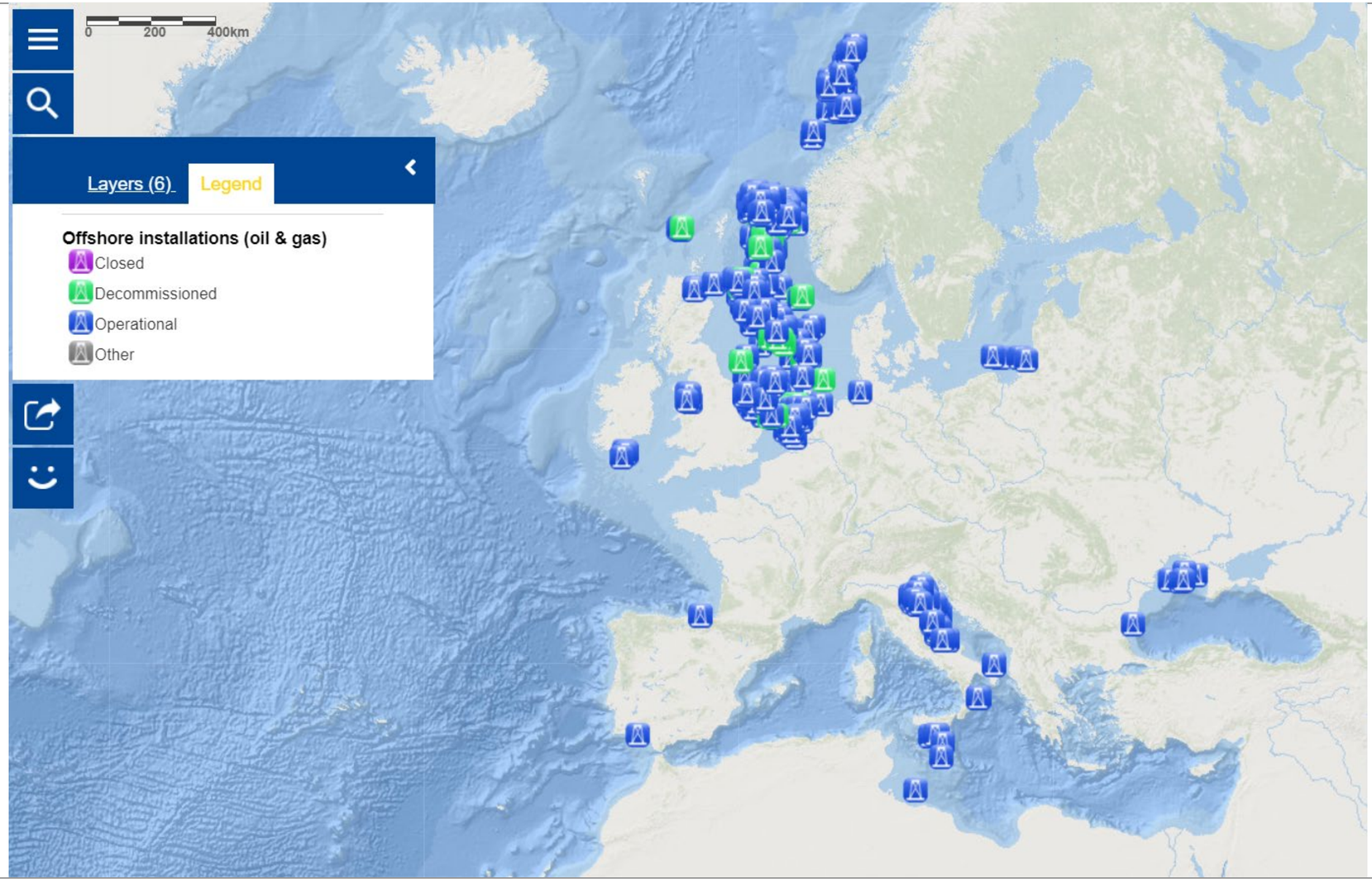
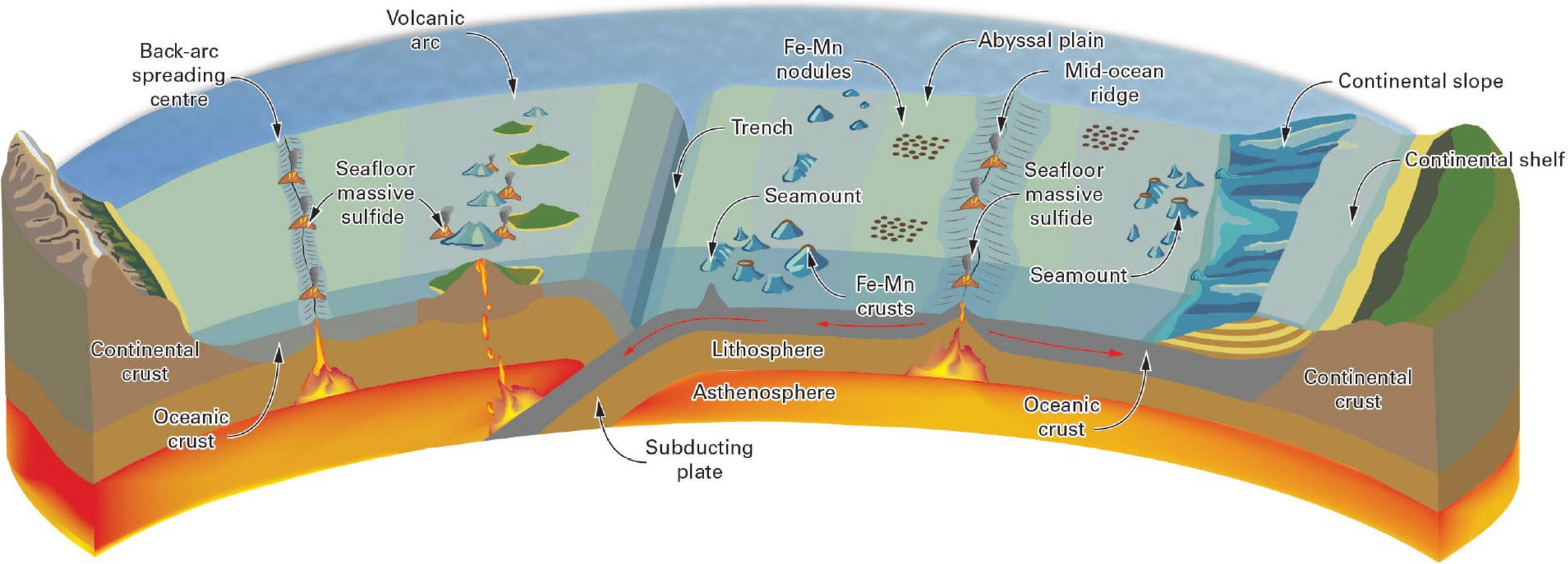
Mineral resources



Mineral resources



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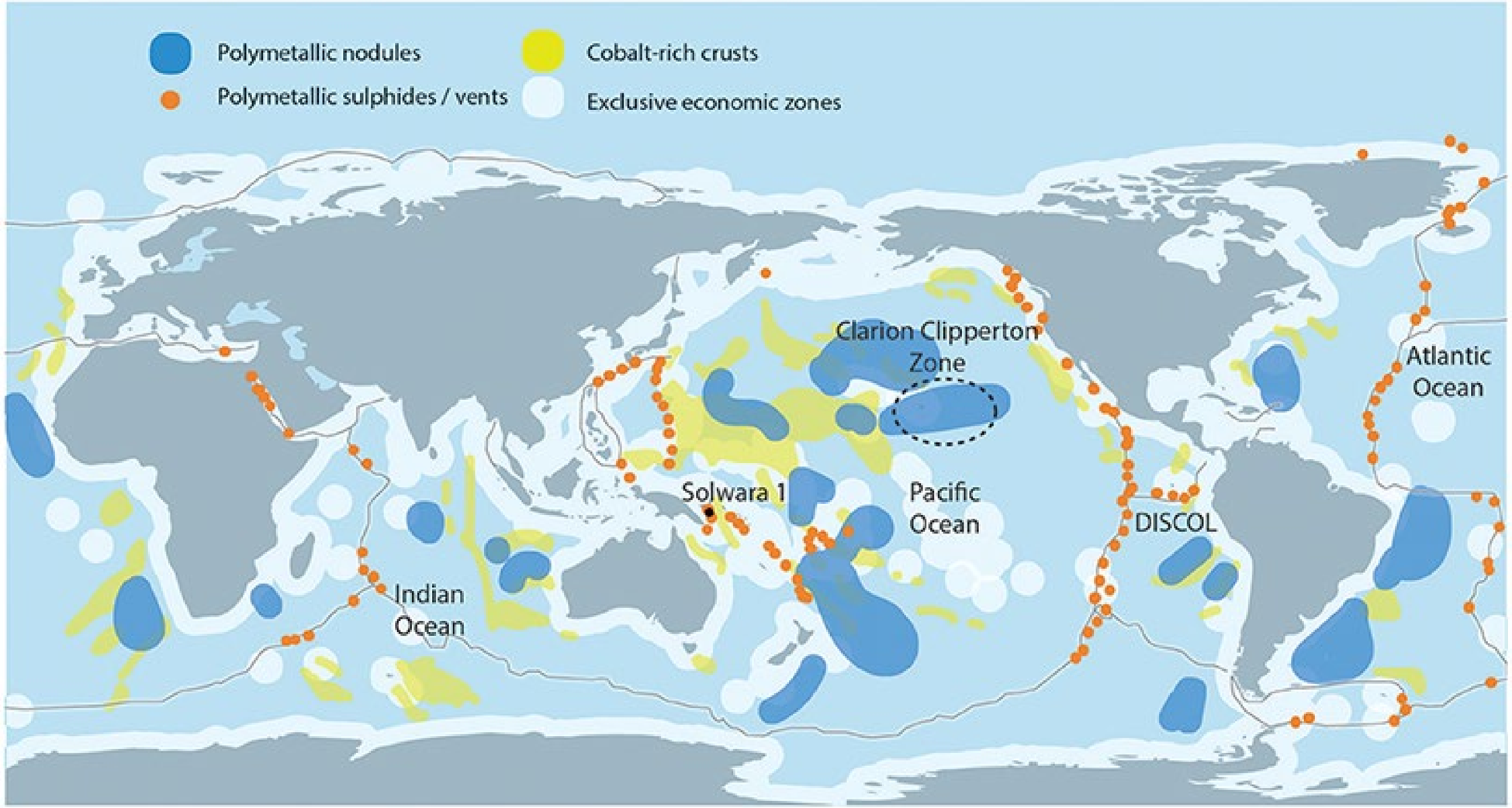
Mineral resources



Mineral resources

- 10^9 ton. of Fe-Mn
  nodules in the Clarion–Clipperton zone (Equatorial Pacific)
- 208 x 10^6 ton. of Ni
  3.5x larger than land reserves
- 40 x 10^6 ton. of Co
  5.5x larger than land reserves

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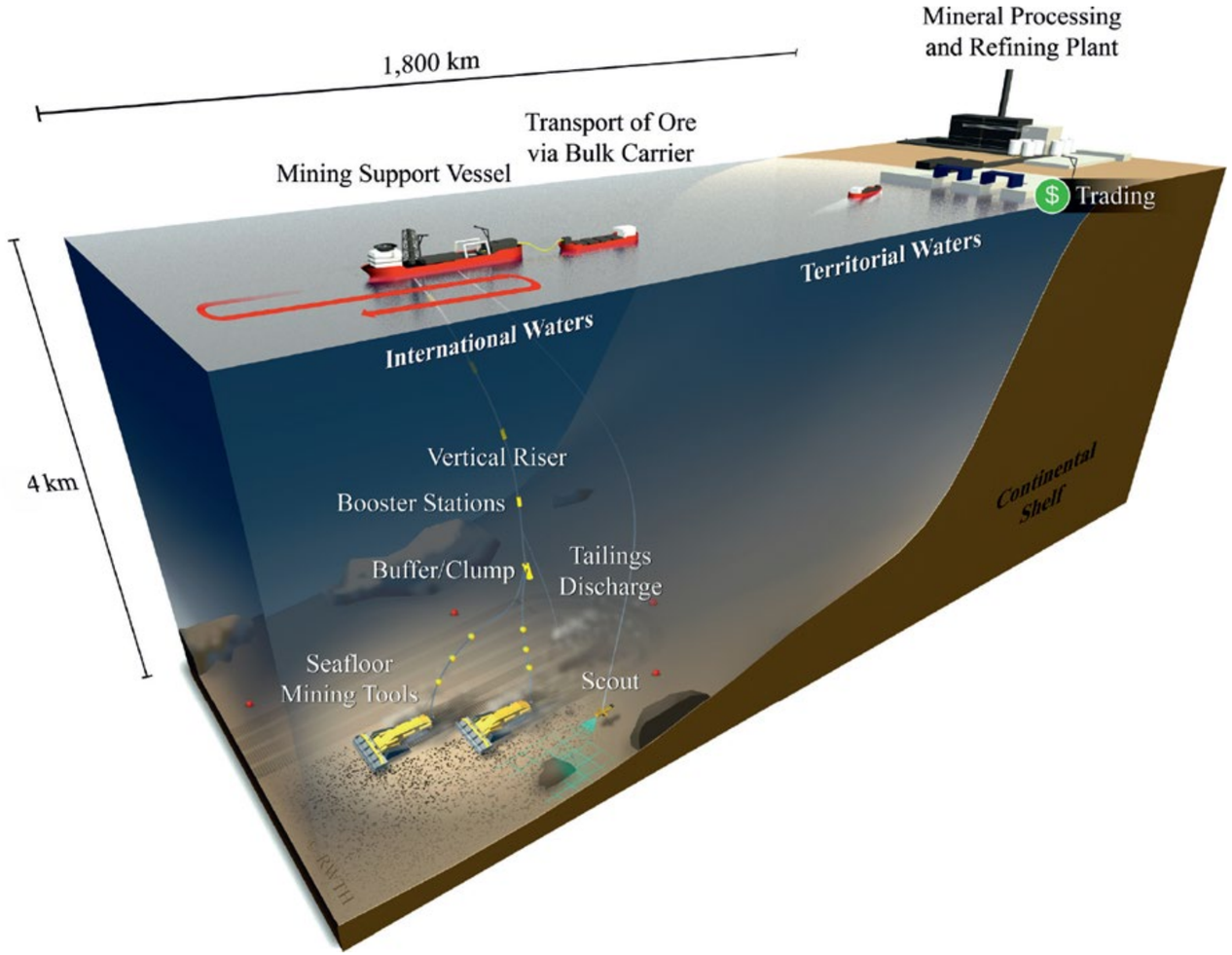
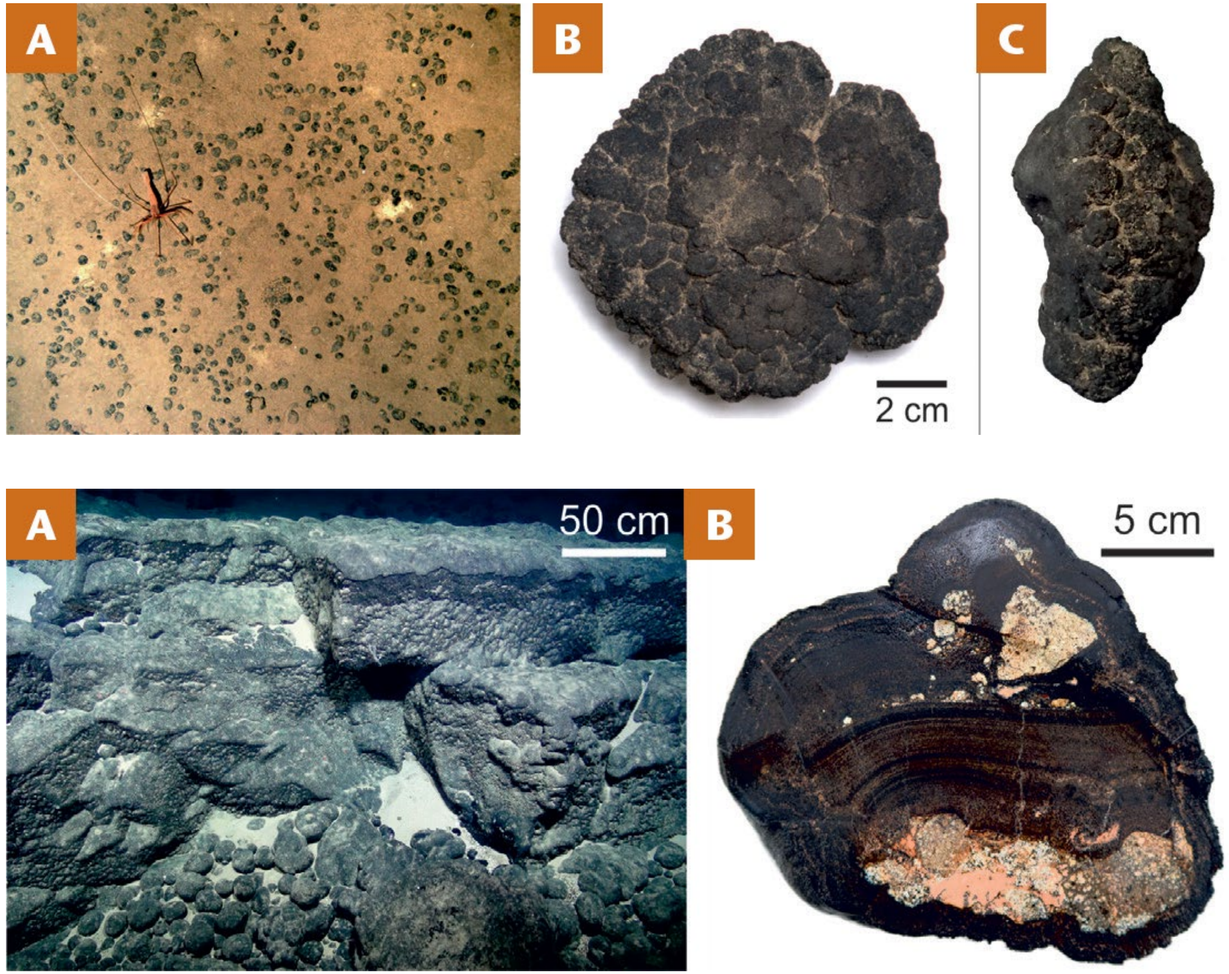
Mineral resources





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Mineral resources

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Energy resources

the seas as a source of energy

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Energy resources

Renewable energy

The sea is an inexhaustible source with the potential to provide a substantial amount of new renewable energy

Waves and tides

Wave and tidal energy can be harnessed to generate electricity to power homes, transport and industries

Other sources

Marine energy also encompasses, or is associated with, other energy sources (thermal, wind, nuclear, etc.).

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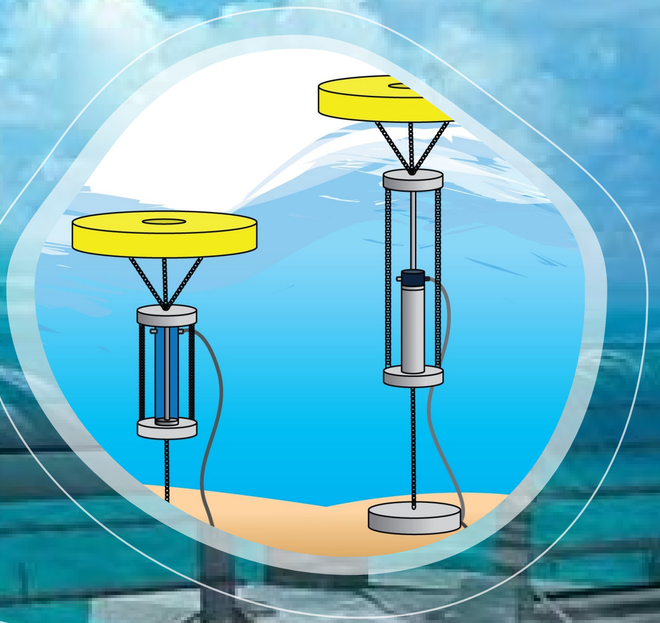
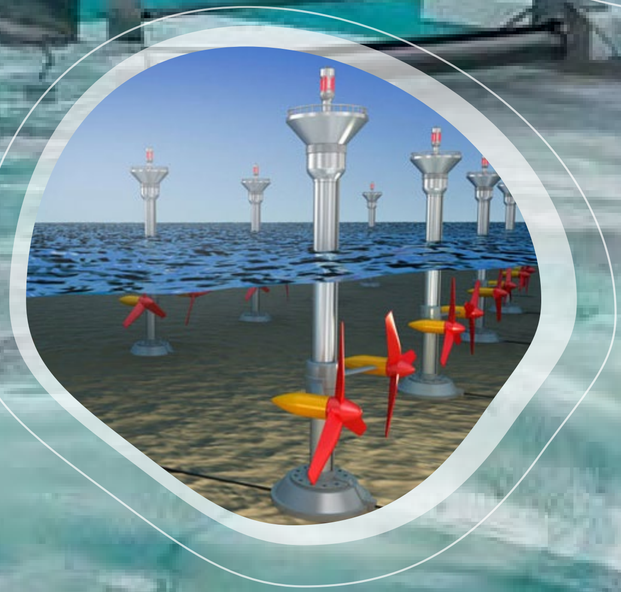
Energy resources





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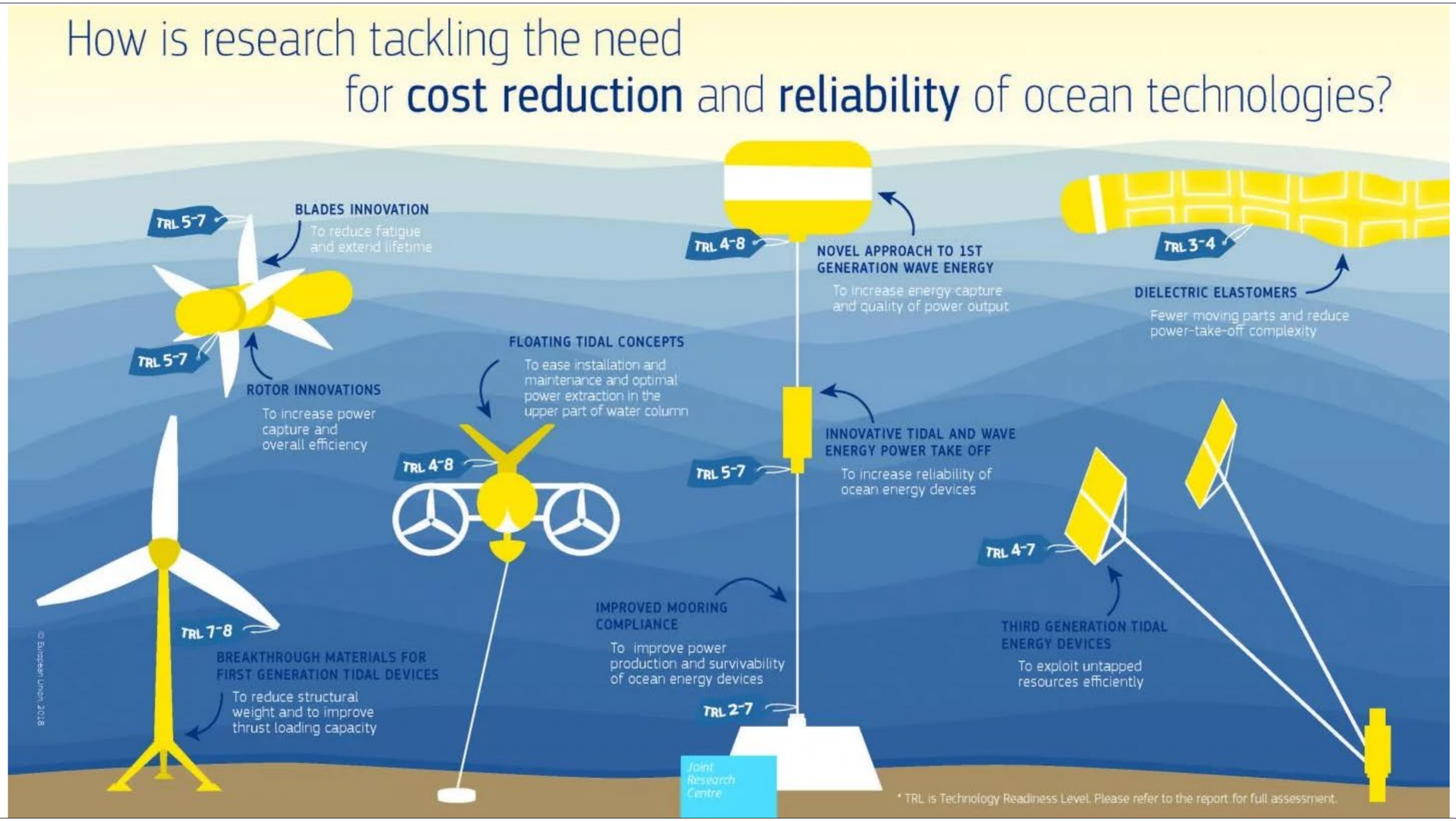

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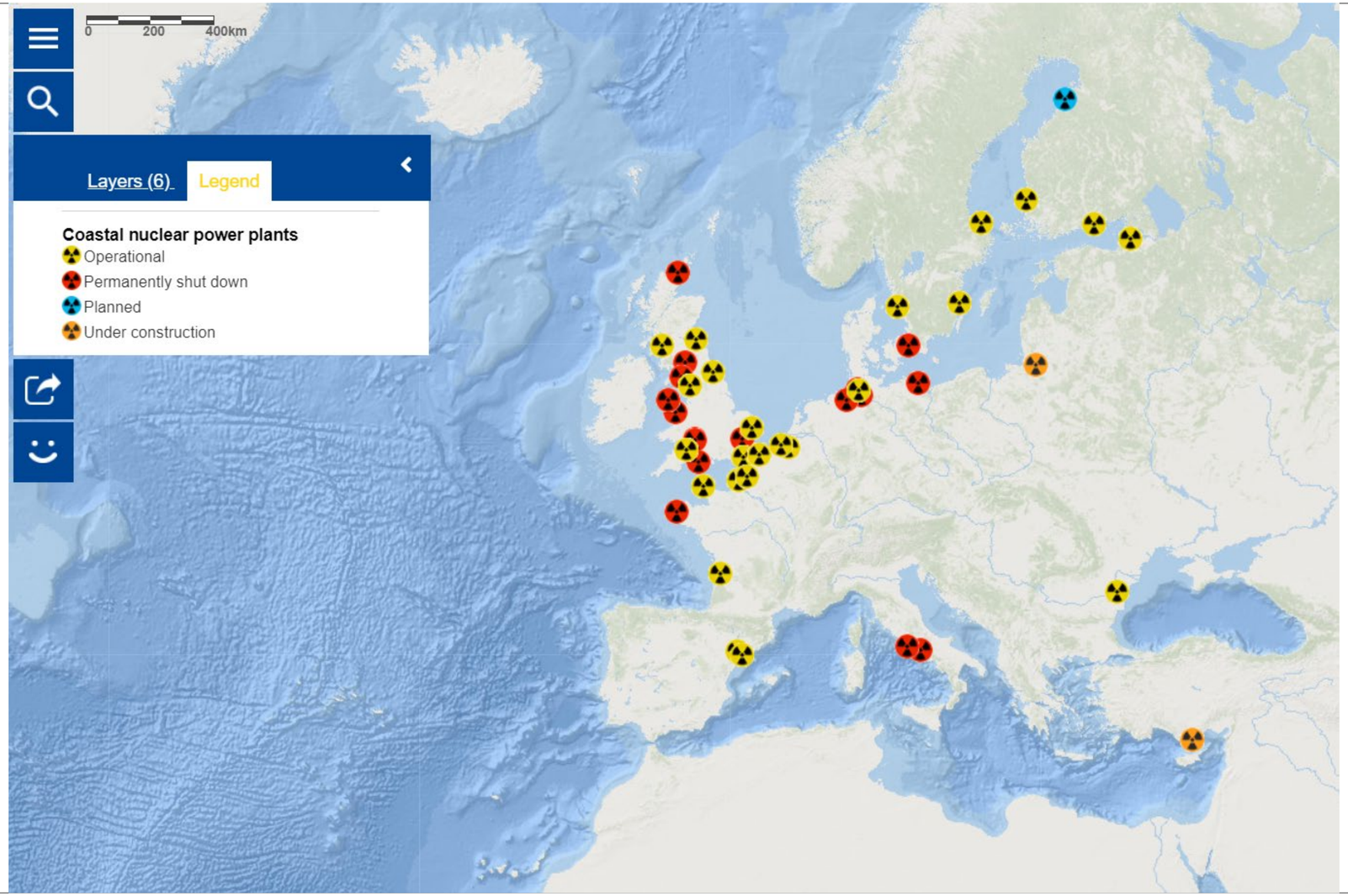

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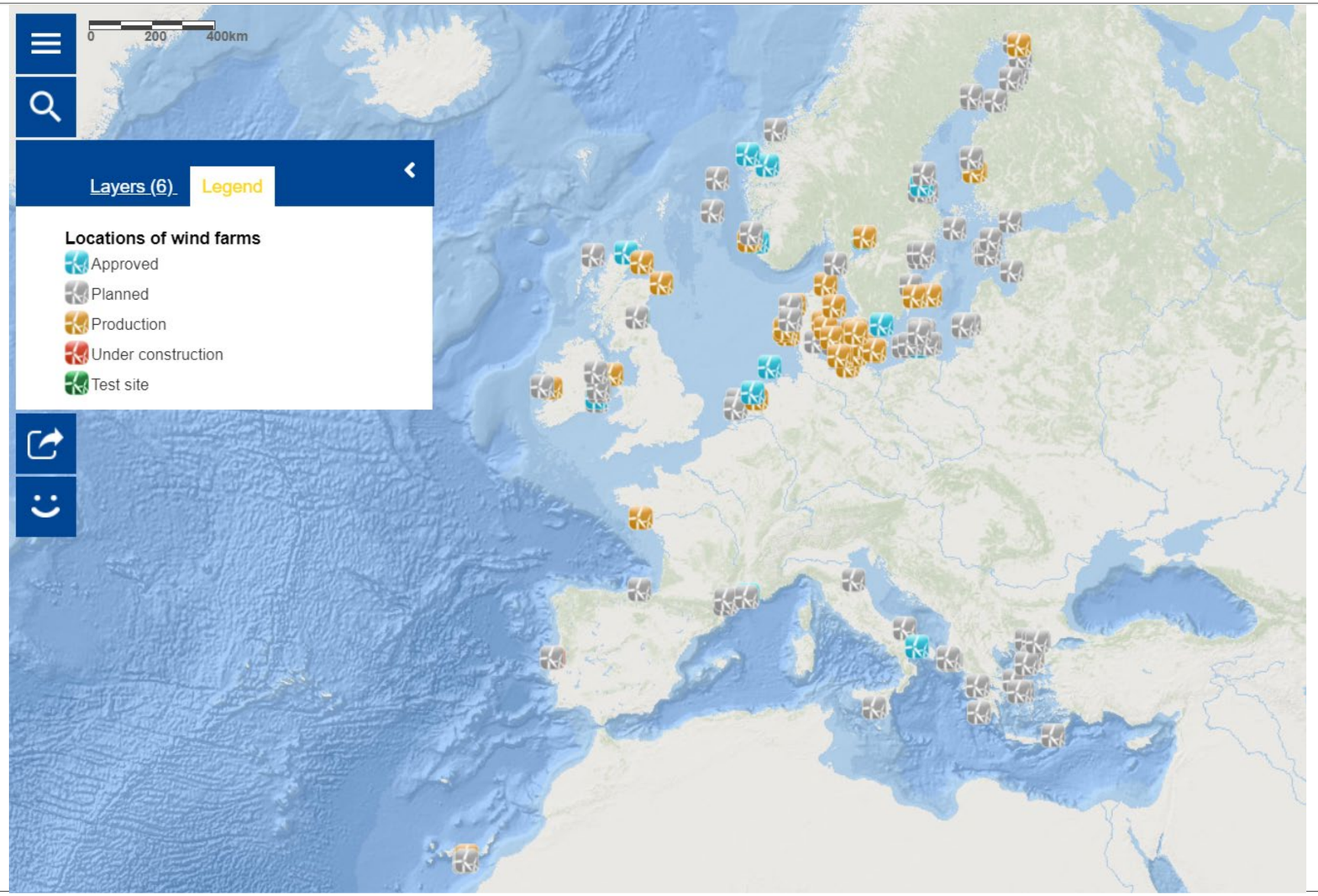

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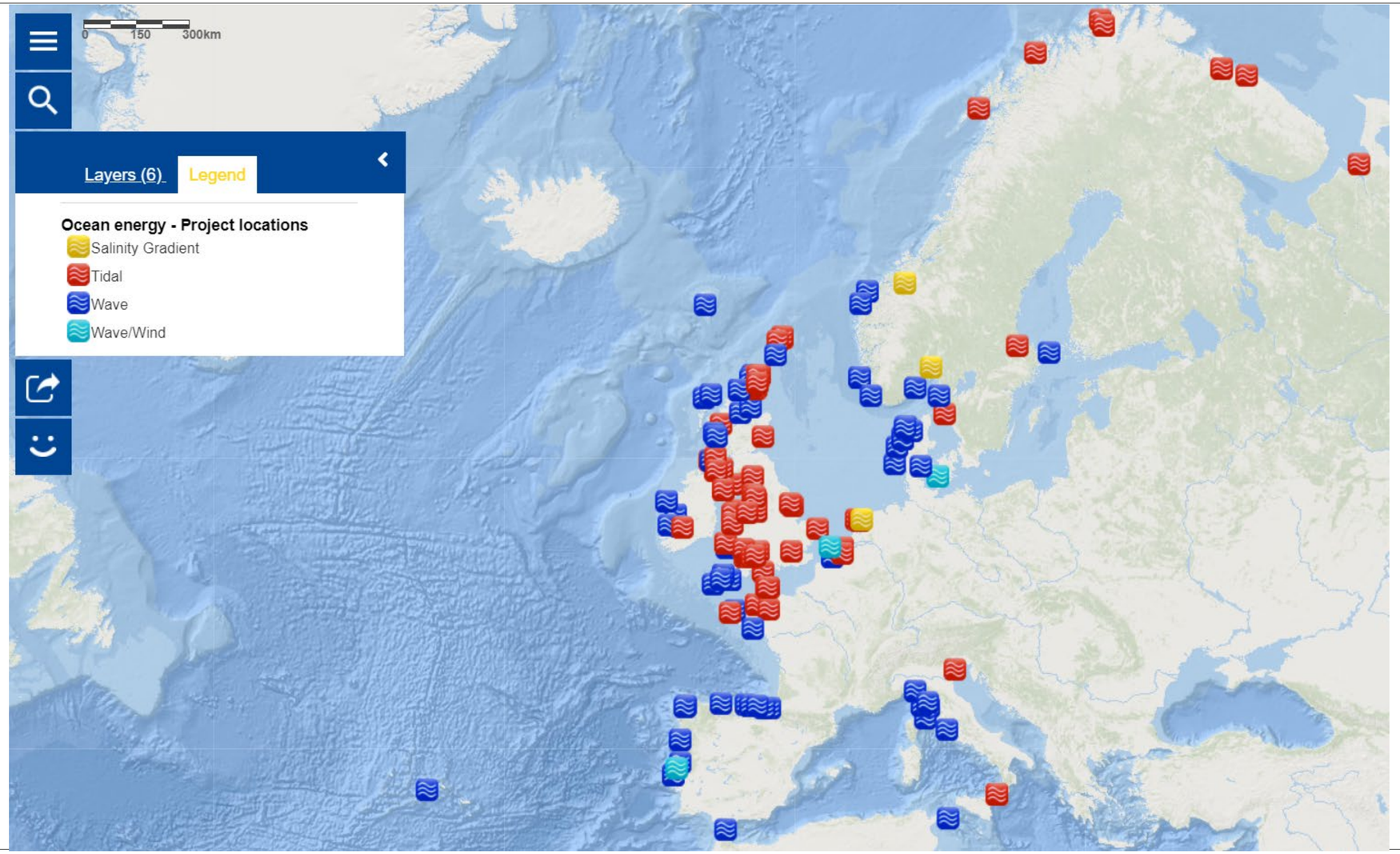

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Hydric resources

the seas as a source of fresh water

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Hydric resources

Abundance

The seas contain about 1,386,000,000 km^3 of water (approximately 97.2% of the world's total water resources)

The problem

This water, however, is not suitable for human and animal consumption, nor to be used in agriculture

The solution

With technology, saline water can be converted into fresh water through desalination

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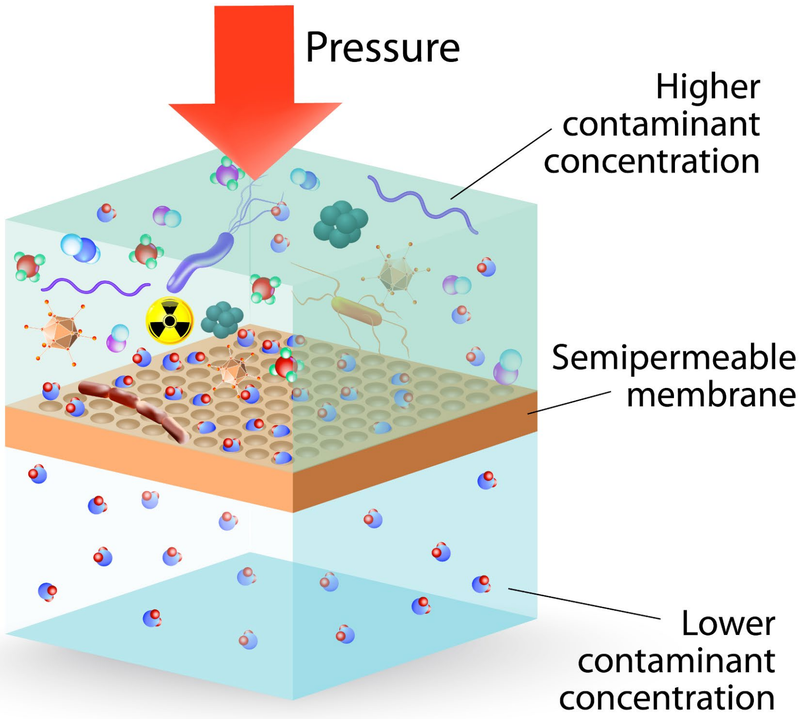
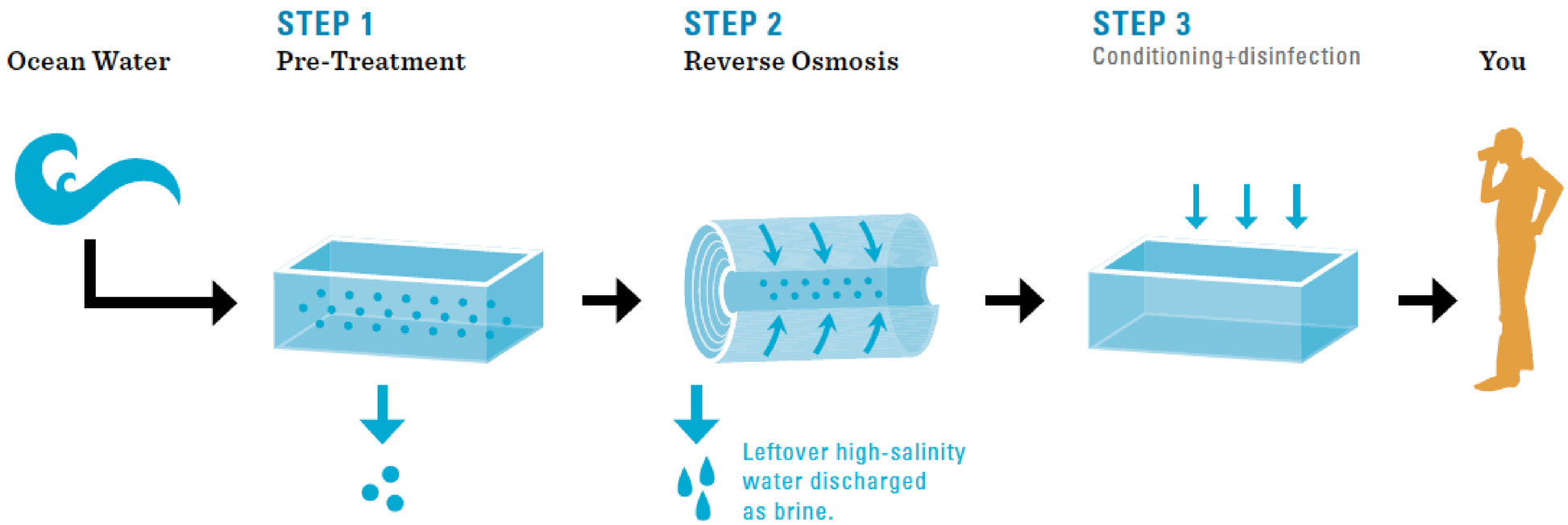
Hydric resources

REVERSE OSMOSIS



Hydric resources



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Hydric resources

20500
desalination units around the world

122 x 10^6 m^3/d
total accumulated desalination capacity

150
countries where desalination is done

300 x 10^6
people who daily depend on desalinated water

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Maritime transport

the seas as
aquatic motorways

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Maritime transport

Transport of persons (passengers) or goods (cargo) by waterways

It can be carried out at any distance, by boat, ship, sailboat, etc., for trade, leisure or for military purposes

Widely used throughout history and a key component of world economies

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Maritime transport

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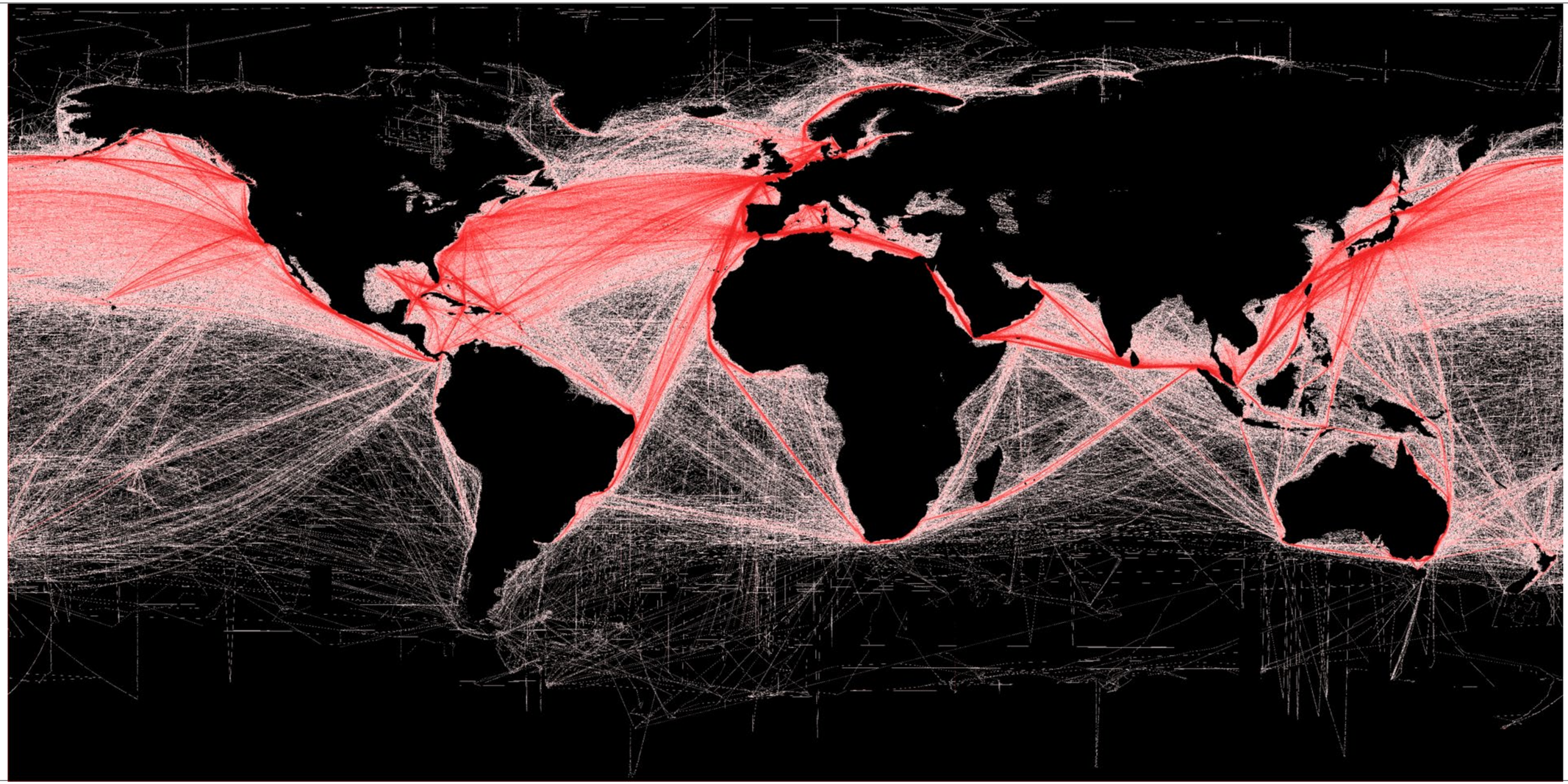
Maritime transport



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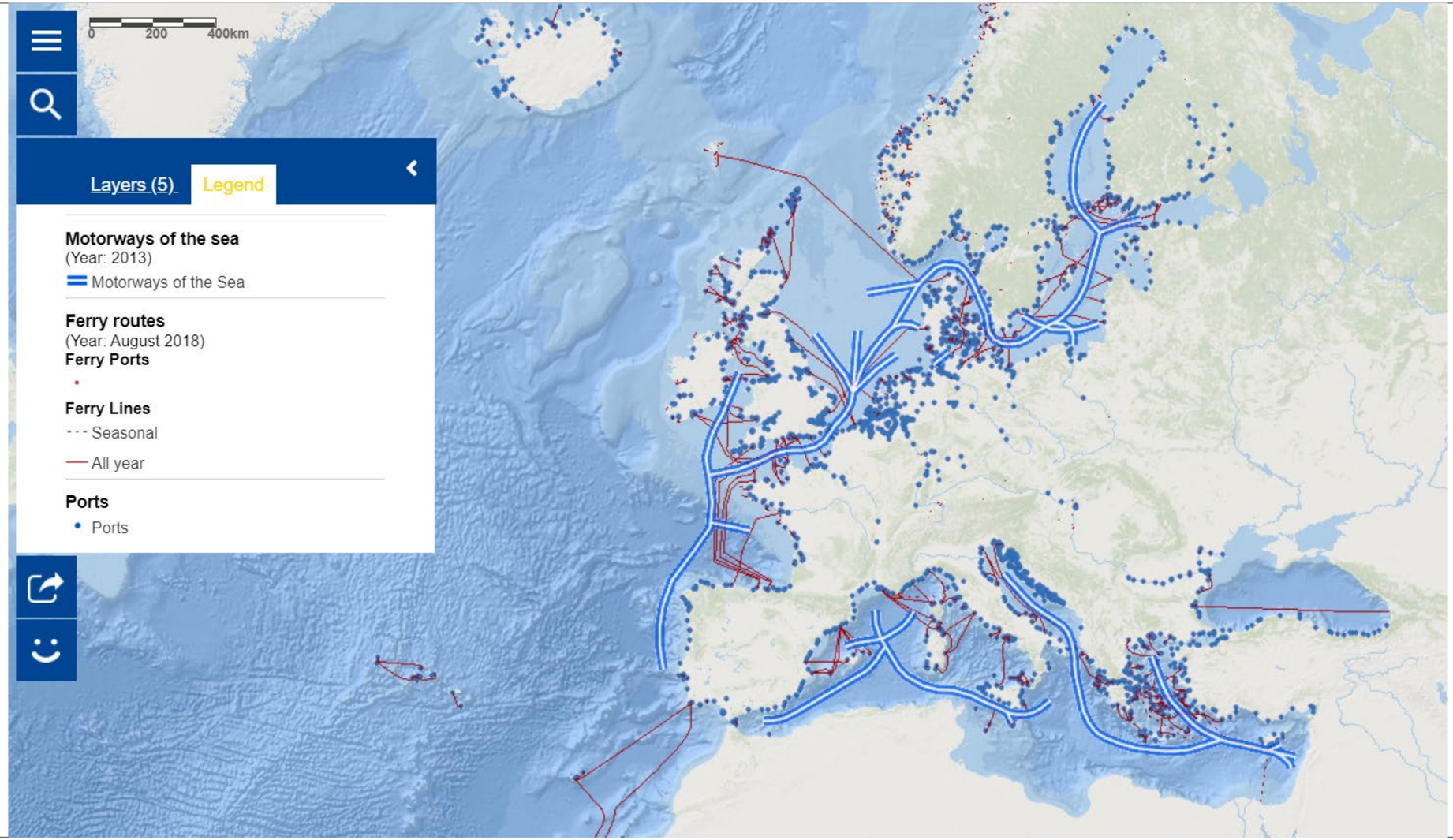
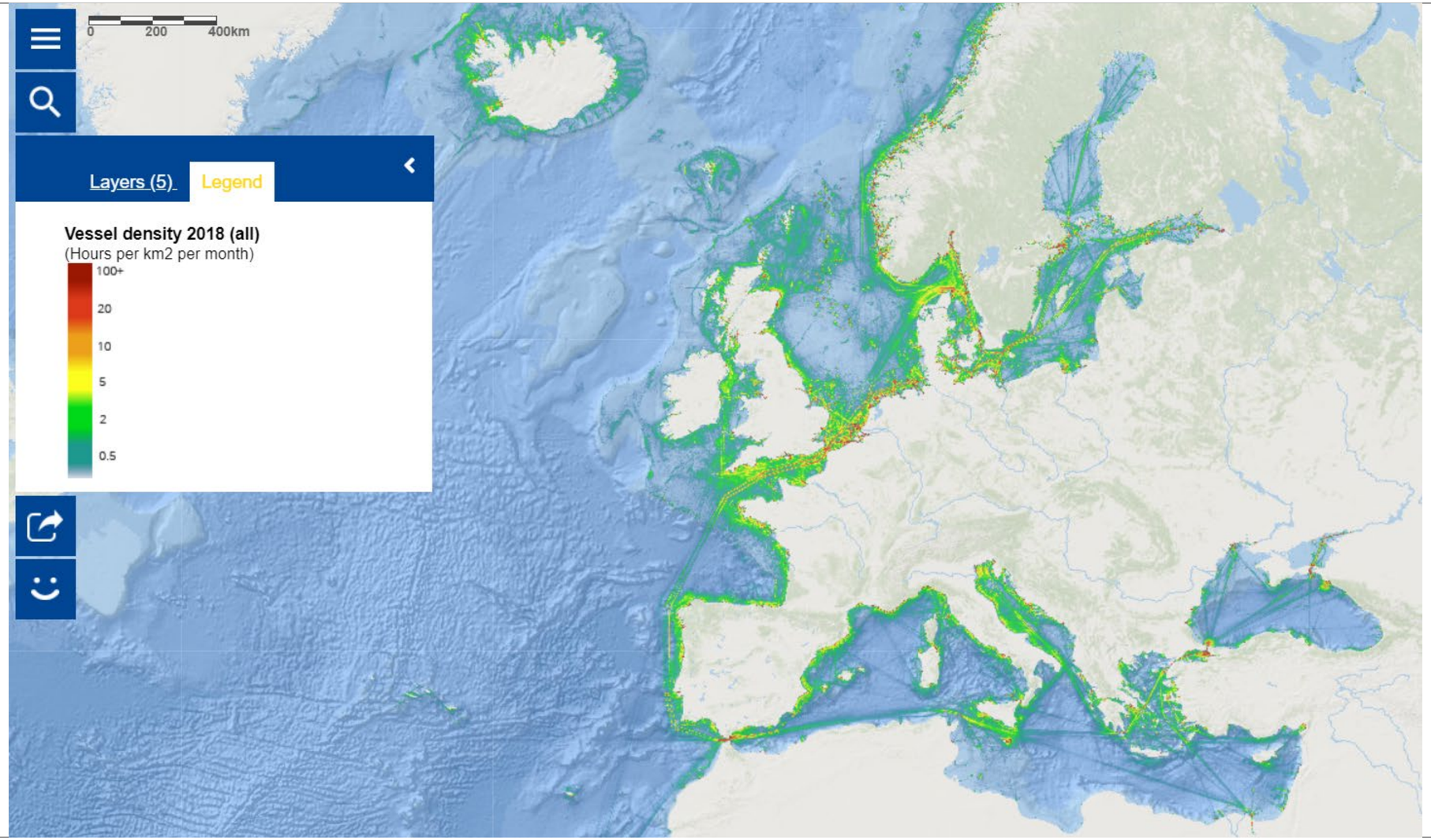
Maritime transport



Maritime transport



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Ecosystem services

the seas as promoters of planetary well-being

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Ecosystem services

Benefits

Ecosystem services, products, conditions or processes that directly or indirectly benefit human beings or improve social well-being; some indispensable to their survival

Undervalued

As they are not purchased and sold directly in the markets, market activities do not fully reflect the benefits they provide

Recognized

Although discussed by scientists and environmentalists decades ago, it became a customary concept in 2000s with the Millennium Ecosystem Assessment

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Ecosystem services

Types of services

Provision

Services related to the ability of ecosystems to provide goods: food, raw material for energy production, biochemical resources, water, etc.

Regulation

Benefits obtained from the regulation of ecosystem processes, such as climate control, CO_2 retention, air purification, water cycle regulation, erosion and flood control, etc.

Cultural

Recreational, educational, aesthetic, spiritual benefits, etc.

Support

Services necessary for the production of all other ecosystem services, such as nutrient recycling, primary production, seed and machine dispersion, etc.

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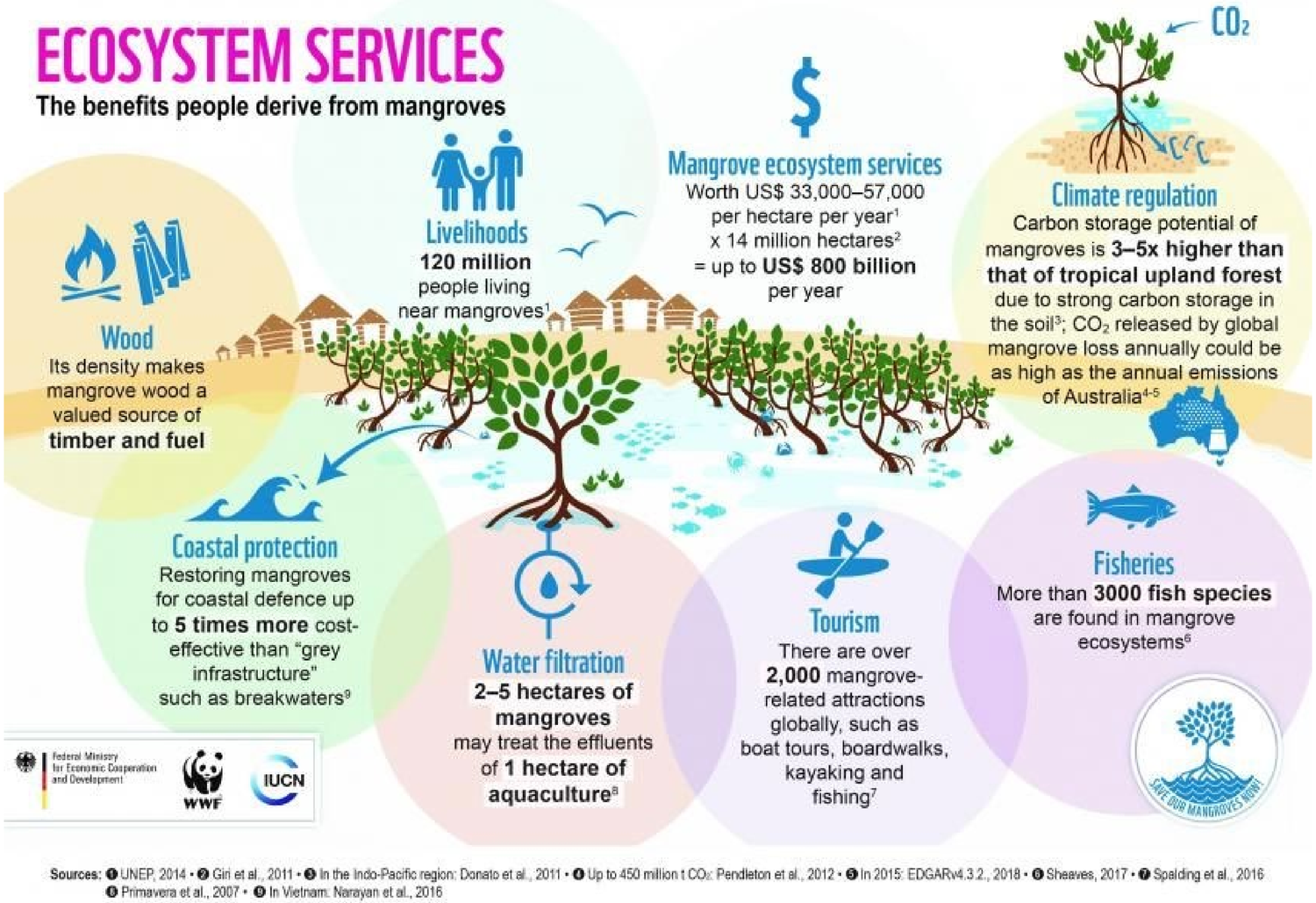
Ecosystem services



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Ecosystem services

MAPPING OCEAN WEALTH

COASTAL BLUE CARBON

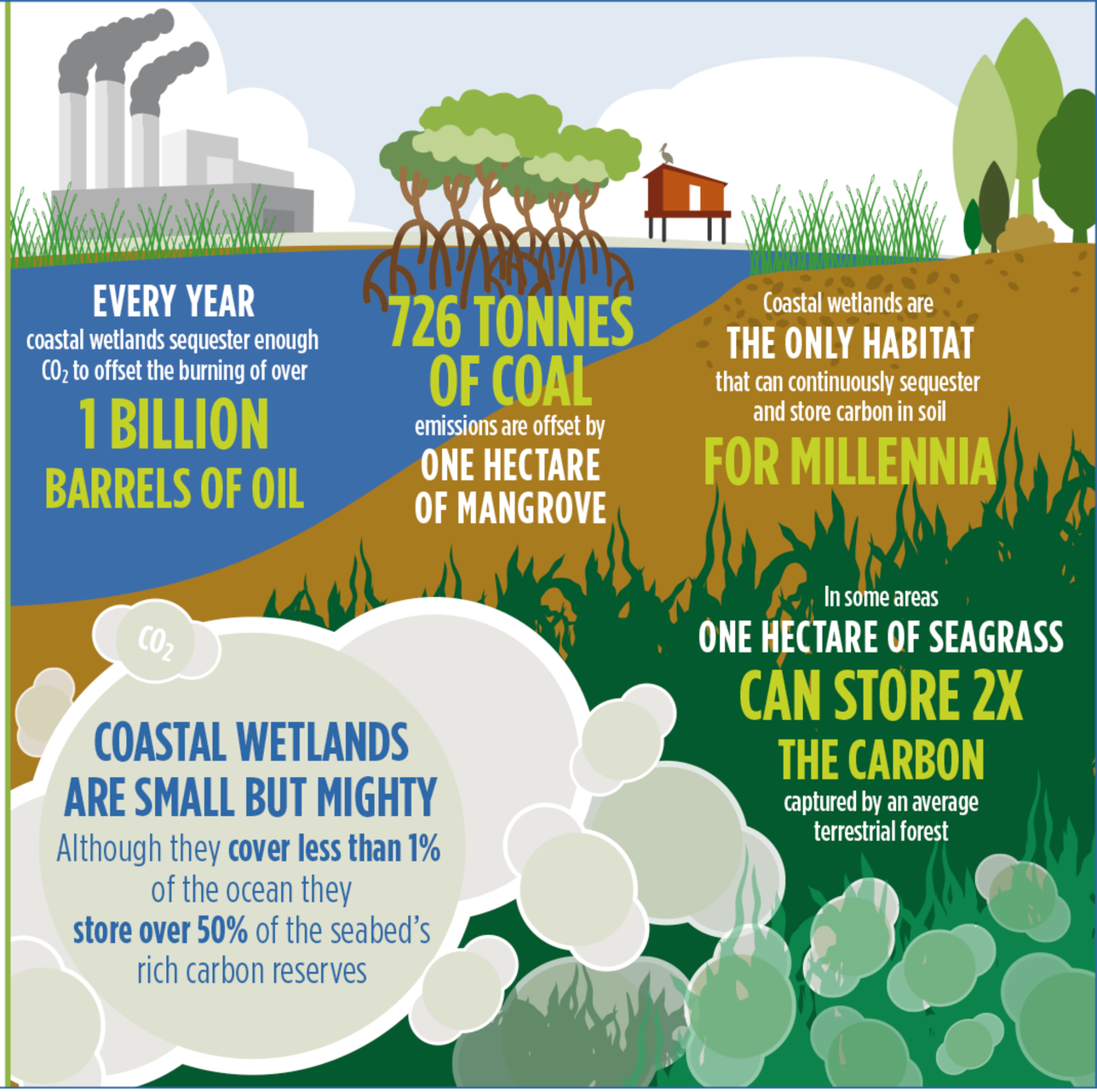
Coastal wetlands – seagrass meadows, salt marshes and mangroves – provide one of the most effective natural solutions for carbon capture and long term storage on the planet.

Policymakers, industry and coastal practitioners should begin now to preserve and restore coastal wetlands because of their climate mitigation and market potential for the benefit of local communities and economies.

Mapping Ocean Wealth demonstrates what the ocean does for us today so that we maximize what the ocean can do for us tomorrow.

oceanwealth.org @ocean_wealth

The Nature Conservancy
Protecting nature. Preserving life.



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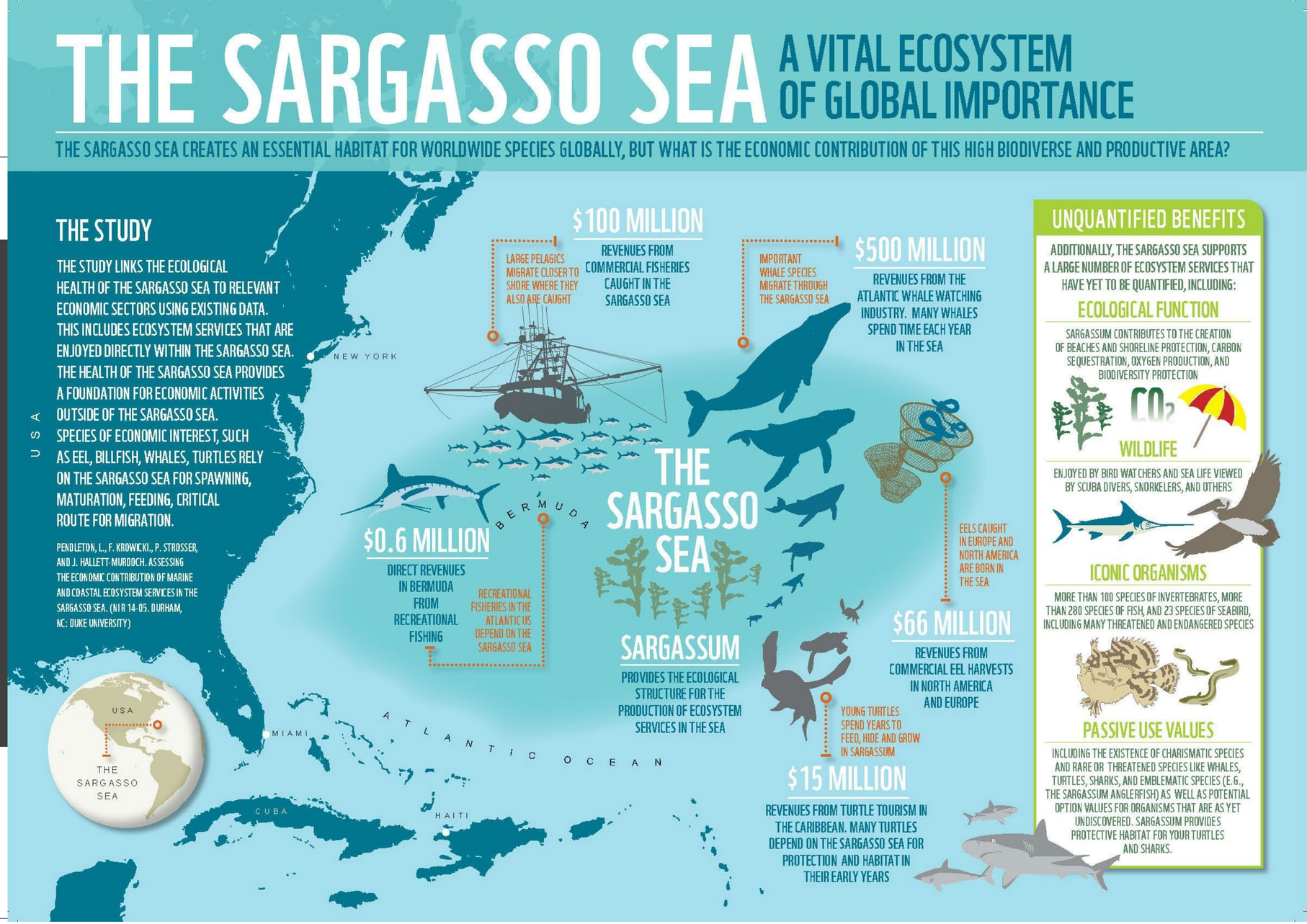
Ecosystem services



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Main threats to marine resources

Sewage

Discharge of waste water, sewage and toxic chemicals

Garbage

Dumping of urban and industrial solid waste from coastal cities

Plastic

Disposal of plastic materials at sea

Destruction

Coastal zone reclaimed for the expansion of ports or other land structures

Hydrocarbons

Leakage or seeping of massive amounts of oil/crude oil from offshore oil tankers and oil wells

CO_2 emissions

Increased acidity of seawater due to increased CO_2 concentration in the atmosphere

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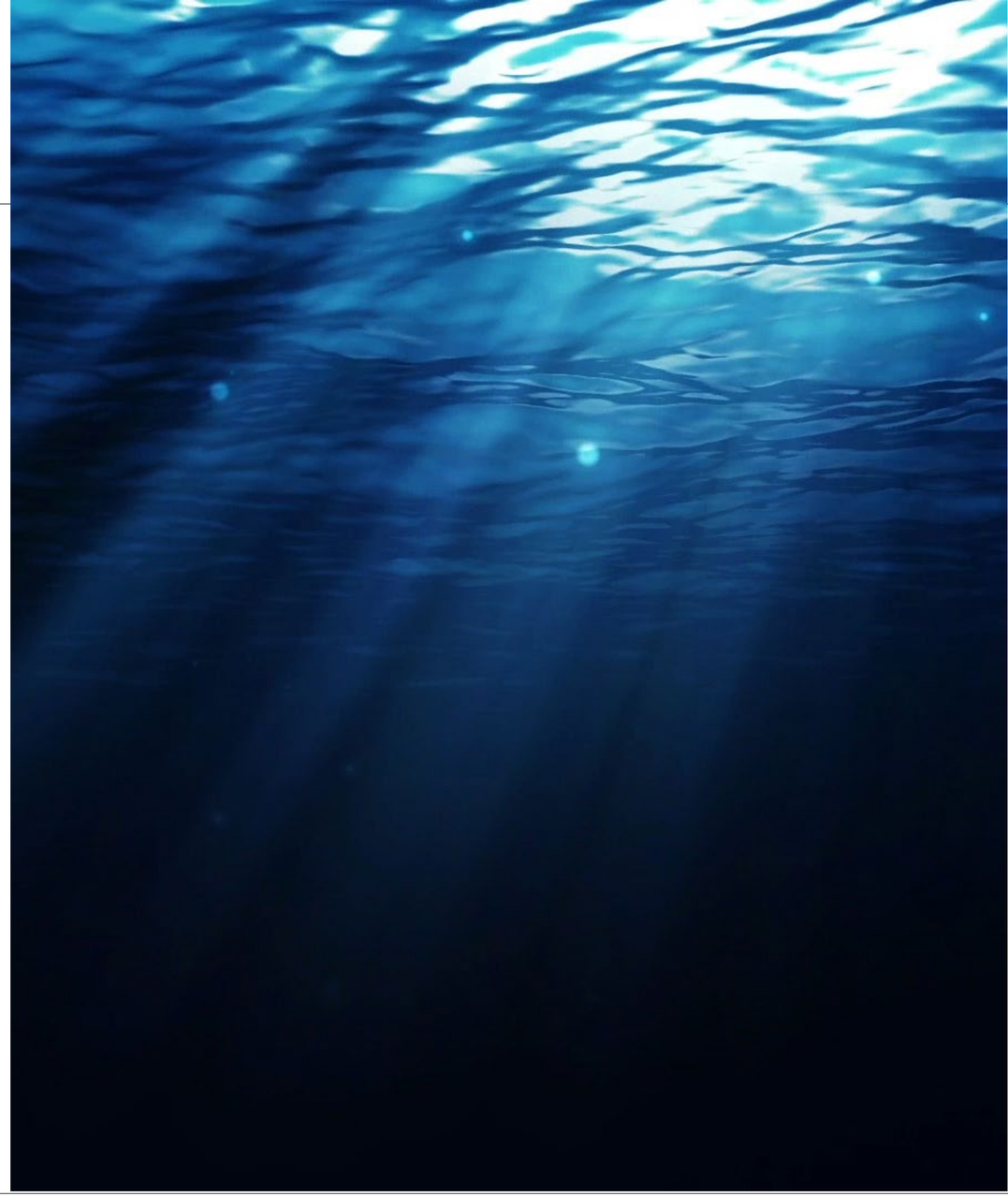
Ulisses

Marine systems…

- are dynamic systems shaped by an interplay of complex physical, chemical and ecological processes, occurring at different time scales
- vary significantly in space (latitude, longitude and depth) and in time (e.g., seasonal patterns)
- can only be managed and their resources harvested with intensive ocean monitoring



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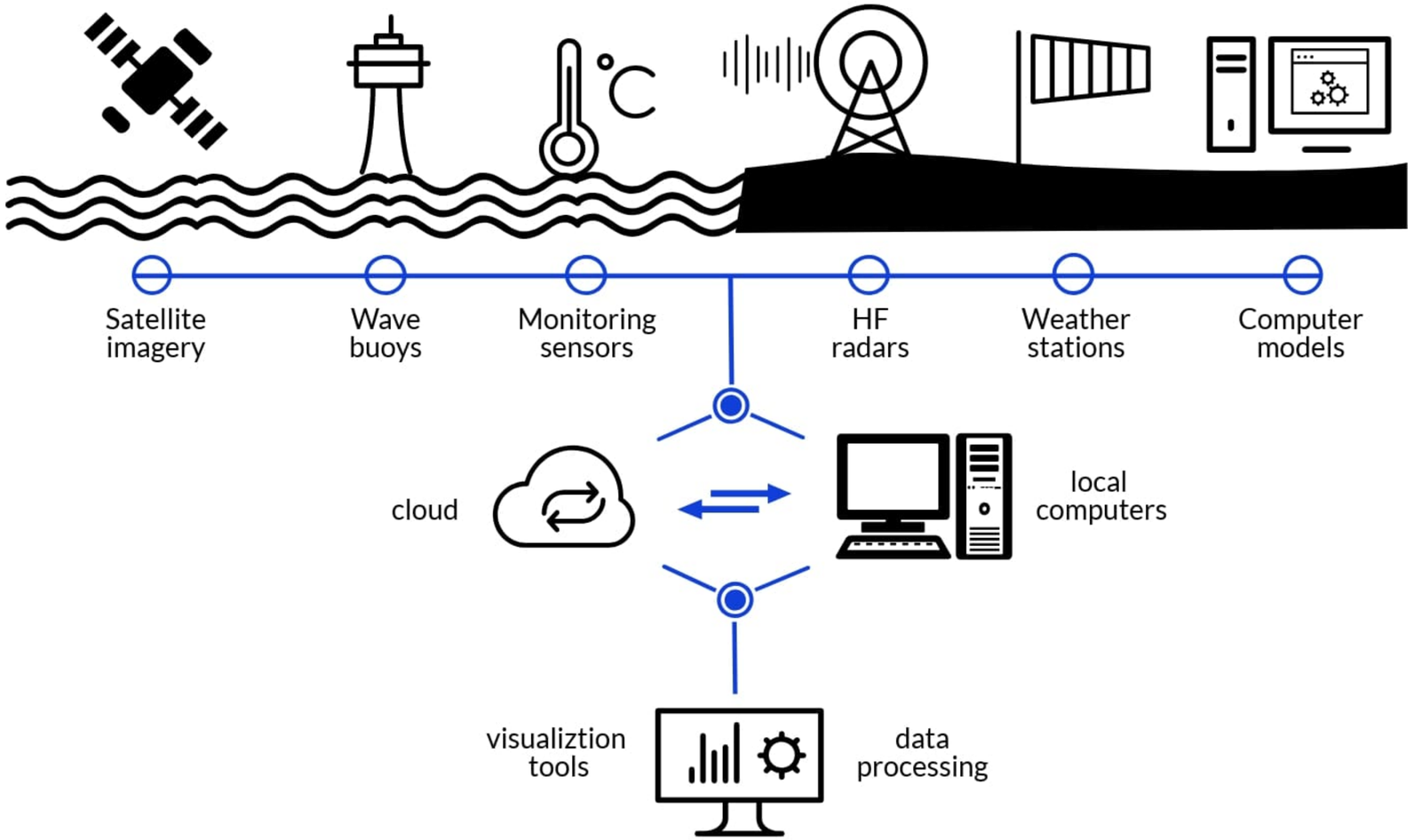
Ocean monitoring



Constant monitoring of the ocean is the only way to know its status, assess its changes and predict its evolution

Ocean monitoring

https://marine.copernicus.eu/

Provide products and services for all marine applications

- Ocean Products
- Ocean Monitoring Indicators
- Ocean State Reports

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