



# MARINE RESOURCES AND ENVIRONMENT MANAGEMENT

Topic 4 - Management Of Marine Resources And Environment  
4.3 Marine and Ocean pollution control system



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# CONTENT

1

- **Marine pollution control system**

2

- **Ocean Pollution control System**

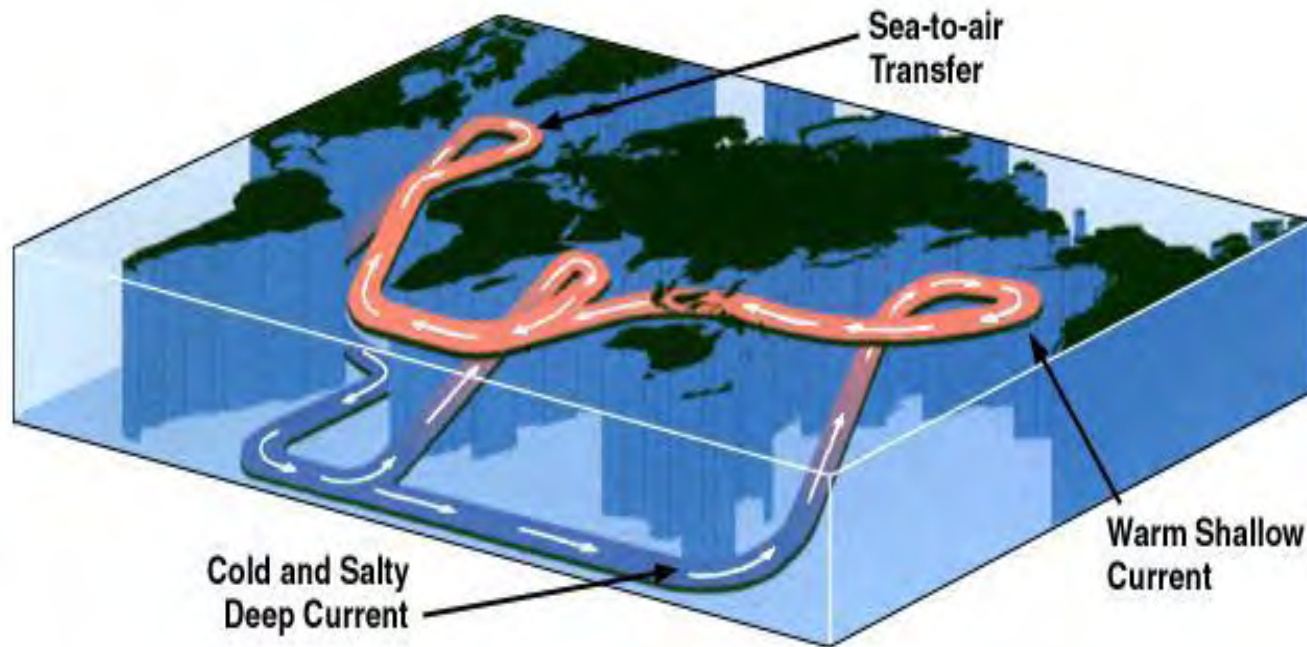


# Marine pollution control system

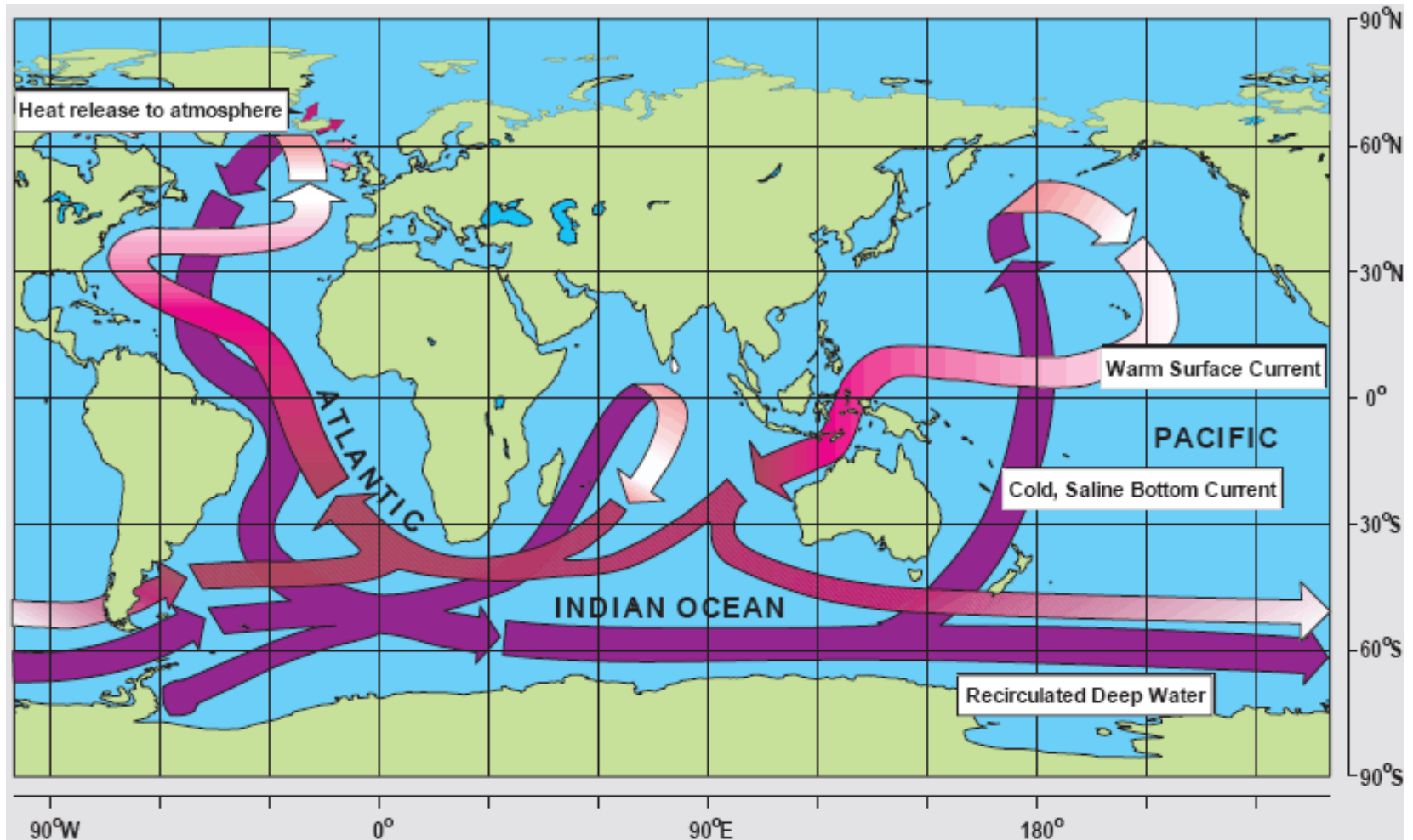


# Processes of pollutant transmission in seas and oceans

## Ocean currents



Currents are a major factor in redistributing heat in seas and oceans horizontally as well as vertically.



Ocean currents between the world's oceans

- ❑ Heat exchange between layers of water near the shore occurs strongly also due to **waves** and **tides**.
- ❑ For **offshore waters**, except where upwelling or tumbling occurs, usually in the aquifer forming a **temperature stratification**.
- ❑ The higher-temperature surface water is separated from the lower-temperature layers by a layer of buffer water, in which there is a sudden change in temperature, called the **thermocline**.

A large blue arrow pointing to the right, indicating a conclusion or next step.

**Pollutants can follow ocean currents, waves, and tides to other places**



Through metabolism, organisms obtain chemical elements in the form of salts from the environment to build their bodies.

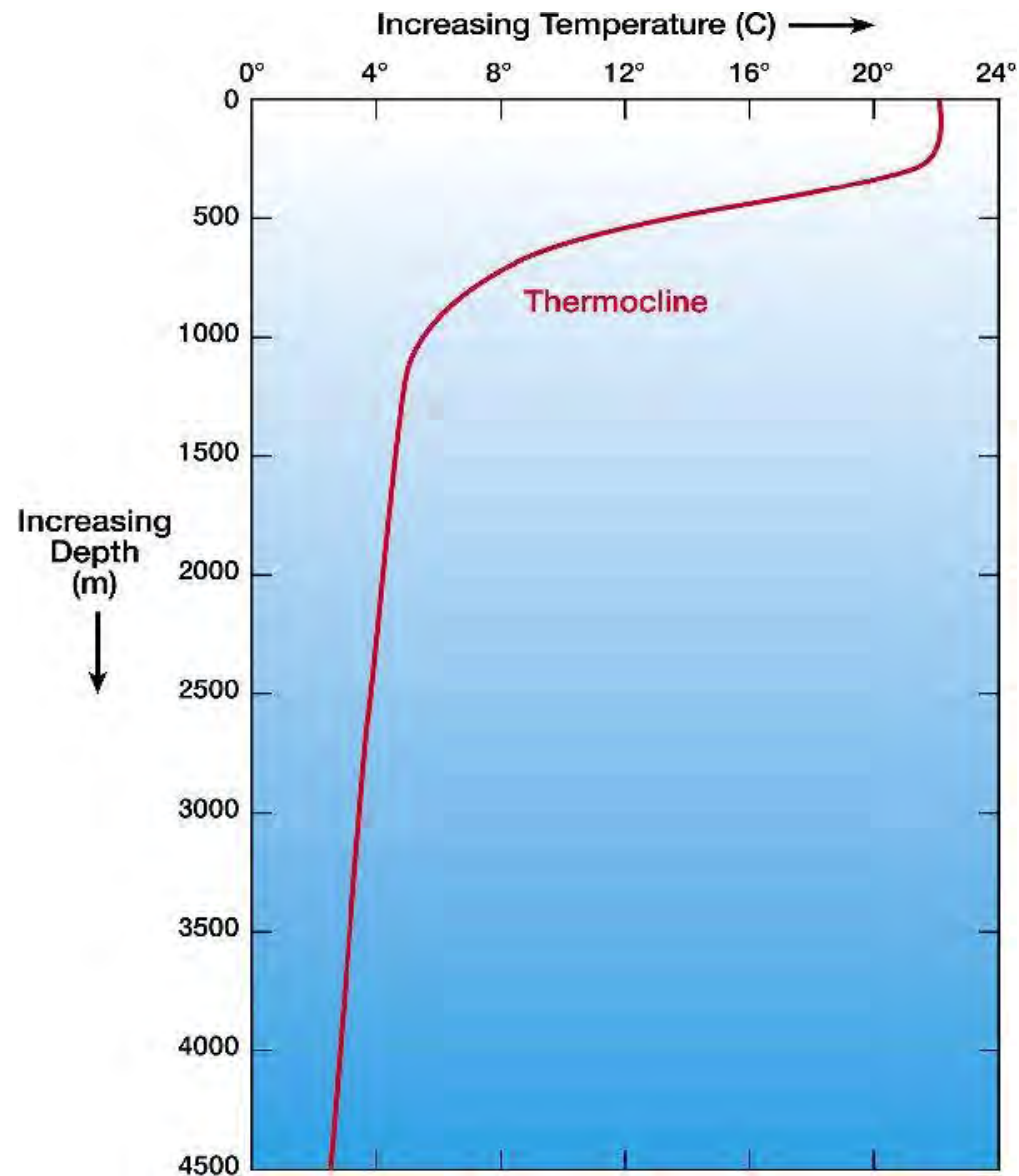


Diagram of ocean temperature variation with depth



# The concept of marine pollution control

- ❑ Control ocean ecology is a system for analyzing, evaluating and forecasting the state of marine ecosystems.
- ❑ The most important component of ecological control is biological control of the marine environment, which includes systematic monitoring of the structural and functional elements of biomes for the purpose of assessing and predicting the composition state biology of marine ecosystems.
- ❑ Biological control is combined with a geochemical control system that examines the sources and levels of marine pollution.

# OCEAN POLLUTION

Pollution of the oceans is widespread, worsening, and in most countries poorly controlled. Human activities result in a complex mixture of substances entering the aquatic environment

More  
than 80%  
arises from  
land-based  
sources

It reaches the oceans through rivers, runoff, atmospheric deposition and direct discharges. Ocean pollution has multiple negative impacts on ecosystems and human health, particularly in vulnerable populations

## PLASTIC WASTE

An estimated 10 million metric tons of plastic enter the seas each year. Plastic pollution threatens marine mammals, fish and seabirds. It breaks down into microplastic and nanoplastic particles that can enter the human food chain

1

## OIL SPILLS

Oil spills kill beneficial marine microorganisms that produce oxygen. They lead also to adisruption of food sources and destruction of fragile habitats such as estuaries and coral reefs

2

## MERCURY

Mercury is released from two main sources - coal combustion and small-scale gold mining. Exposures of infants in utero when pregnant mothers eat contaminated seafood can cause IQ loss and serious developmental disorders. In adults, mercury increases risks for dementia and cardiovascular disease

3

## MANUFACTURED CHEMICALS

Manufactured chemicals such as phthalates, bisphenol A, flame retardants, perfluorinated chemicals, and pharmaceutical waste cause multiple diseases. They can also reduce human fertility and damage coral reefs

4

## PESTICIDES

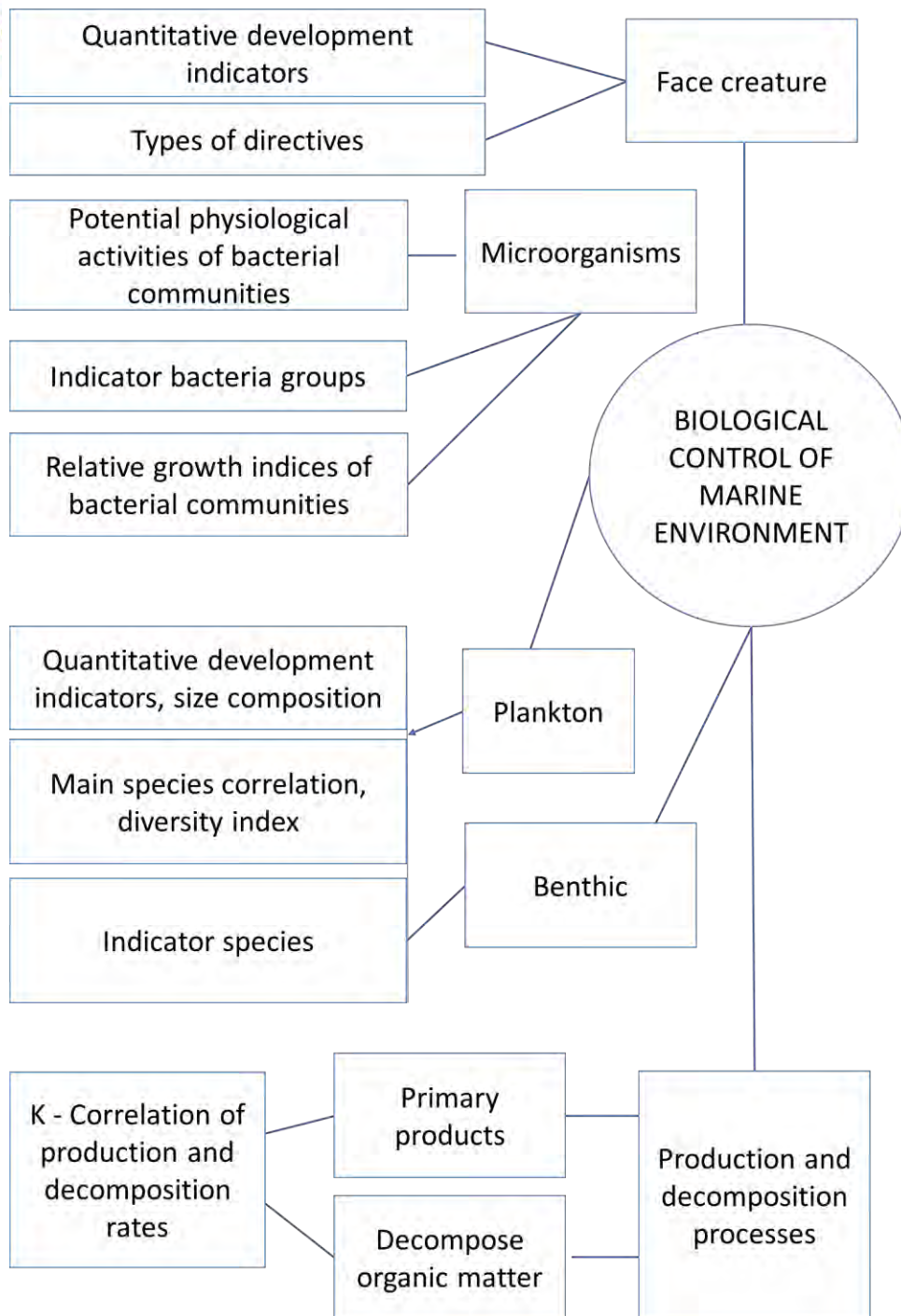
Pesticides sprayed on crops often end up in the ocean via rivers and watercourses. They contribute to global declines in fish stocks, and can also reduce human fertility

5

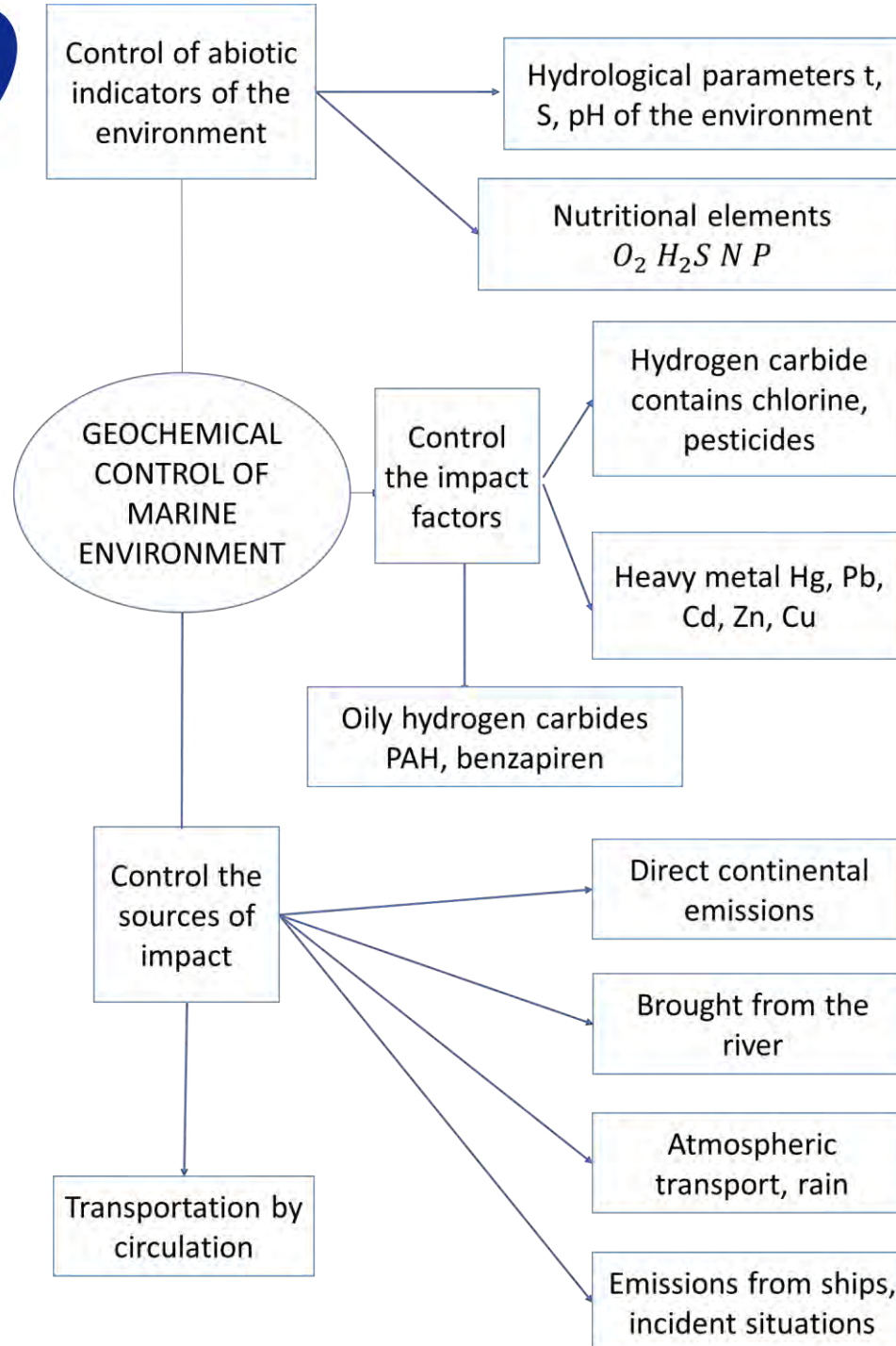
## NUTRIENTS

Agricultural fertilizers, animal feedlot waste, and human sewage increase the frequency of harmful algal blooms, accelerate the spread of life-threatening bacteria, and increase anti-microbial resistance

6

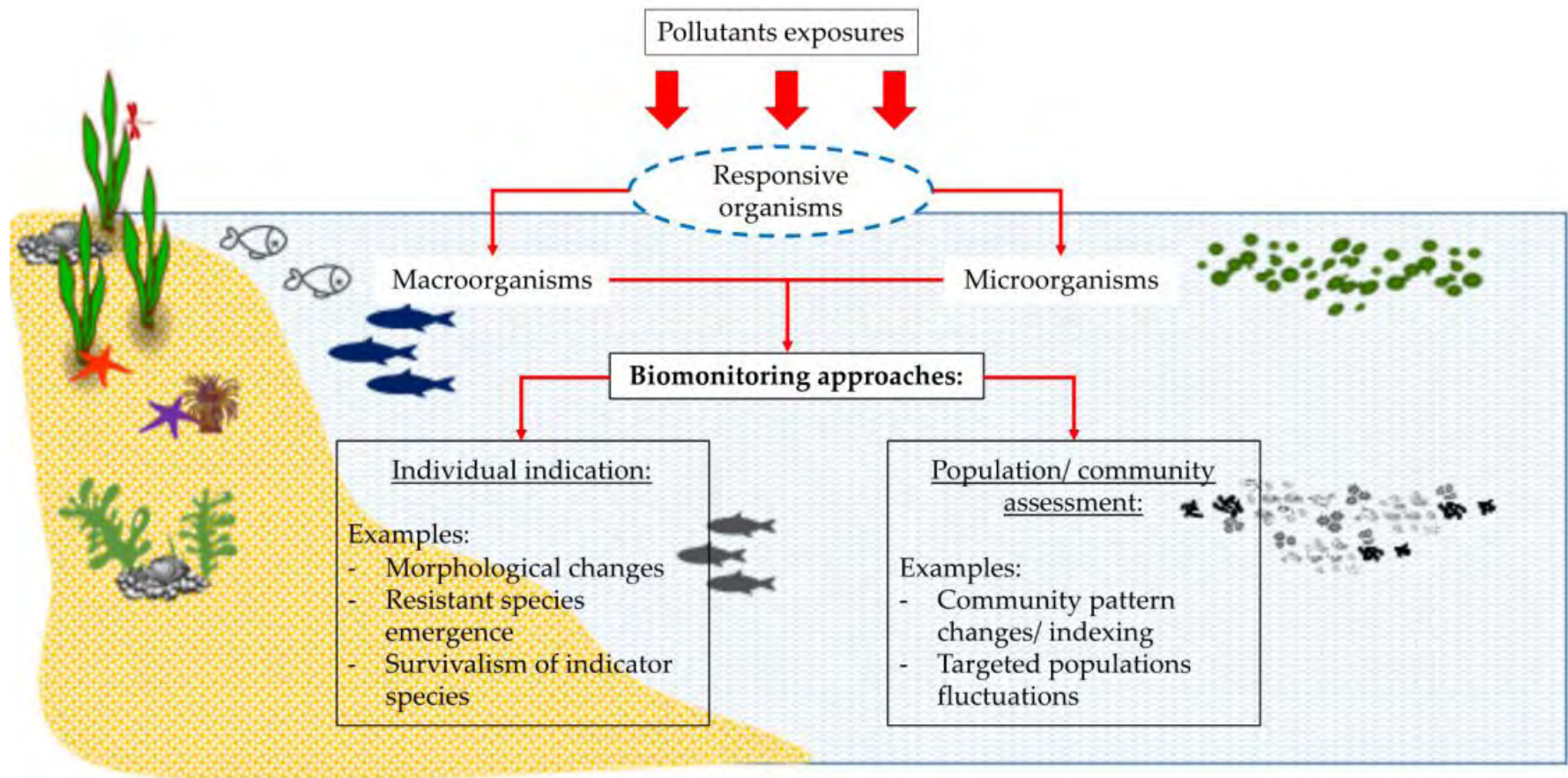


Indicators for biological  
control of the marine  
environment



Indicators for  
geochemistry control of  
the marine environment





Biomonitoring aquatic pollution by utilizing either indigenous macroorganisms or microorganisms which are affected by the presence of pollutants



# CONTROL OF MARINE POLLUTION

## Tasks and scientific basis for integrated control of marine pollution

- The purpose of the Integrated Marine Pollution Control is to **determine the state** of the most important ecosystems of the World Seas and Oceans, thereby making **predictions** about the **changes** taking place in the ecosystems under the impact of anthropogenic factors.

## Identification of channels of entry and assessment of pollutant flows in the bio-rich and vulnerable ecosystems of the World's Seas and Oceans.

- Solving this task based on field observation data allows to detect the main sources of infiltration and carriers of pollutants, assess the self-cleaning processes of the marine environment, calculate the balance components by pollutant.
- Studying the **entry, accumulation and decomposition** of pollutants in the most biologically productive oceans, in the microscopic surface layer, and in the deep water layers of the oceans has important practical implications.
- Research on the adsorption of pollutants by suspended substances of biological and mineral origin, their transport to the ocean floor, their continued accumulation and metabolism under microbial action in closed bottom sediments significant role.

## Studying negative pollution consequences in the bio-rich and vulnerable ecosystems of the World Ocean

- The task is to determine against the background of natural **oscillation** of the properties of marine ecosystems to find out the **changes** caused by anthropogenic factors.
- The information received will reflect the current ecological situation and provide a **scientific basis** for forecasting possible changes in the future performance of marine ecosystems.
- Study the cause-and-effect relationships between pollutant accumulation levels and observed ecological changes. Determination of critical concentrations of pollutants capable of disrupting functional biological and biochemical processes.

## Studying the physical, chemical and biological processes that determine the settlement capacity and assessing the tolerance capacity of marine ecosystems in the most studied regions of the World Ocean

- When pollutant concentrations in the environment reach levels that exceed the tolerance of ecosystems, they begin to affect the survival, reproduction, growth, and mobility of aquatic organisms.
- As a result, the distribution, quantitative and qualitative parameters of species and populations are altered.
- It is a necessary basis for benchmarking external impacts on marine ecosystems and for forecasting the status of ecosystems.

## Building mathematical models for discrete ecological processes to predict ecological situations in the ocean at region, area and global scales

- The basis for building a mathematical model of the operation of the marine population is formed from extrapolation methods for the integral characteristics of the population.
- The largest predictive value belongs to the models of medium complexity, this is due to the non-stop in operation of the ecosystem.

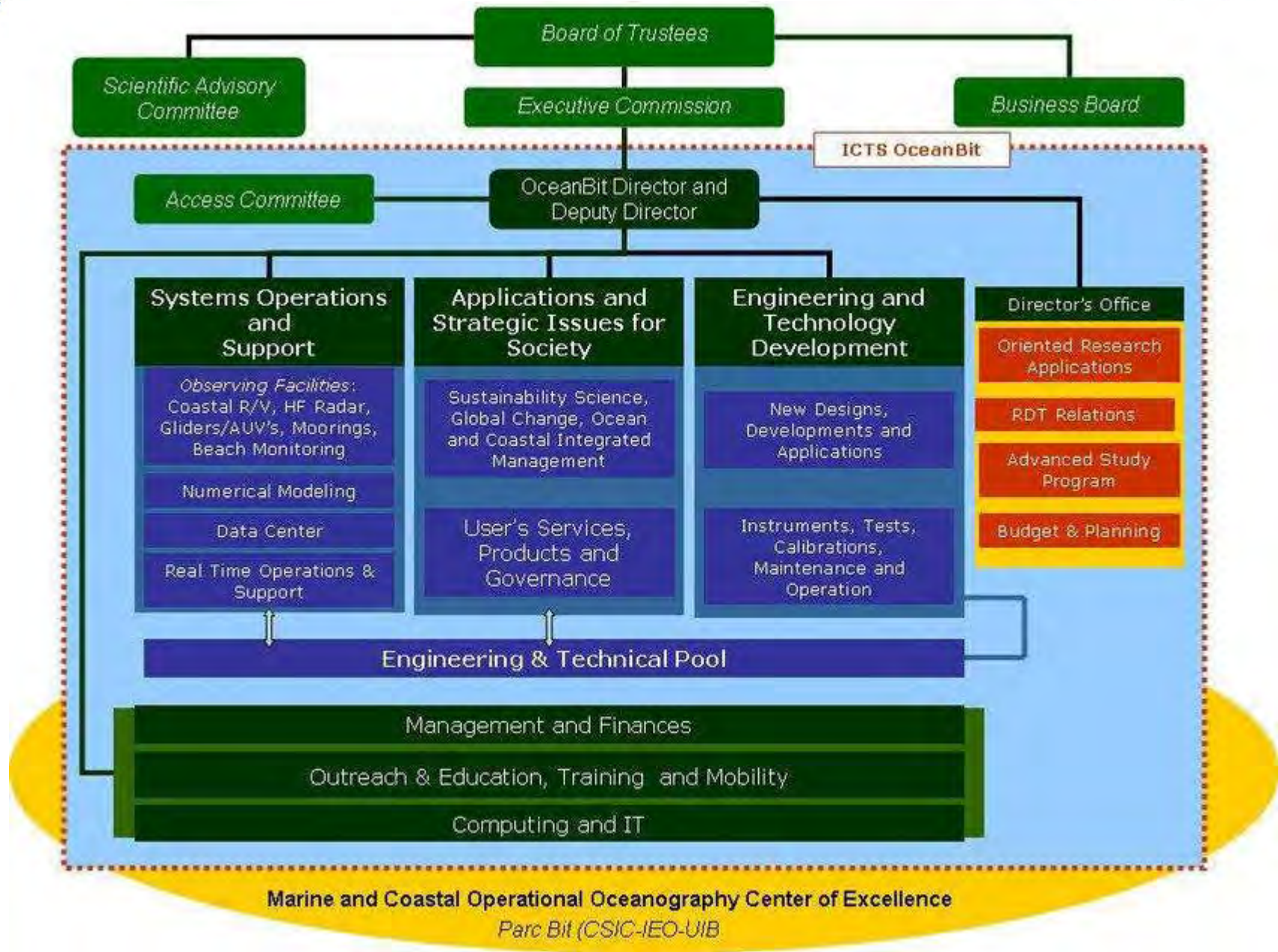


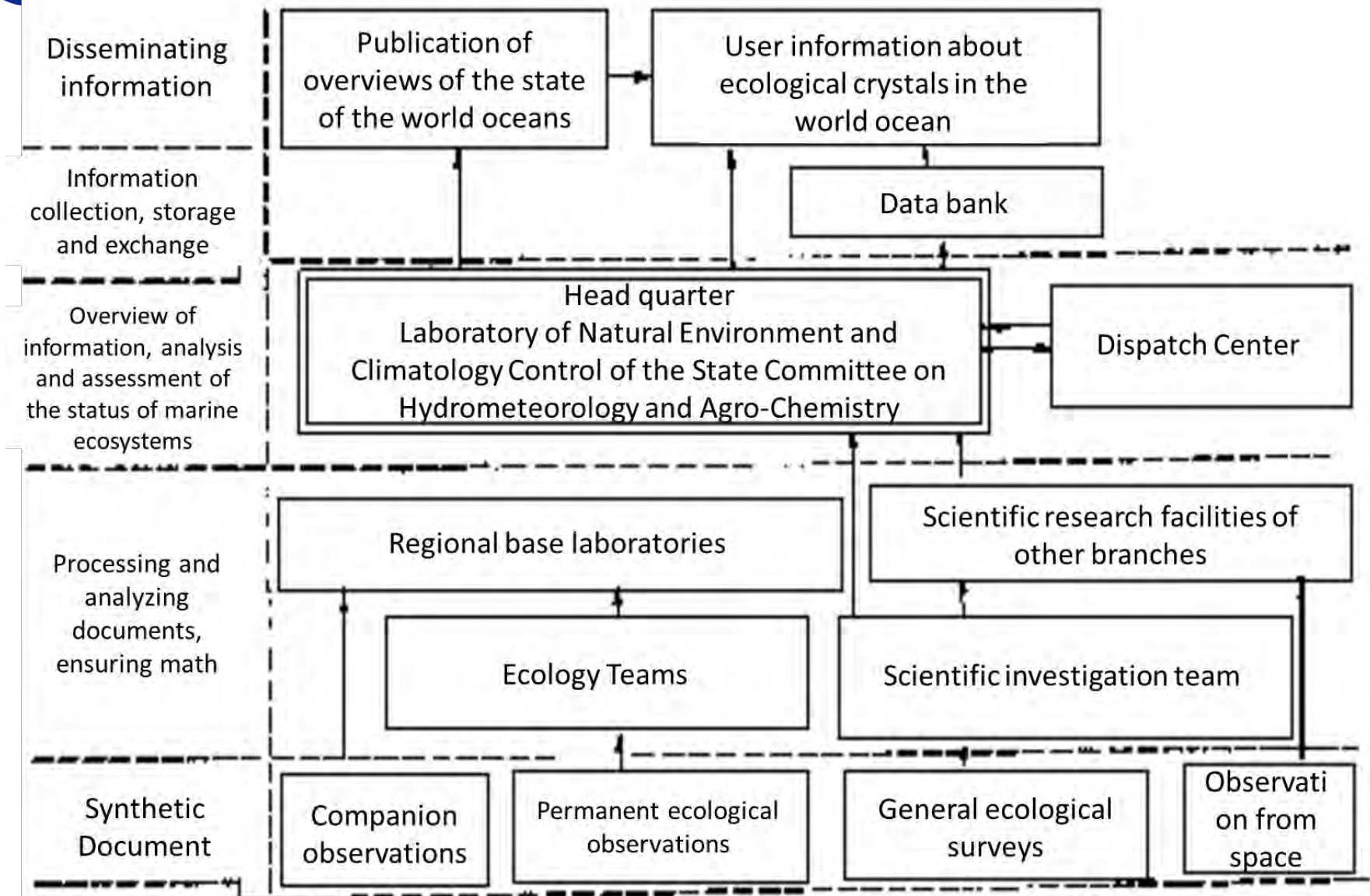
## OCEAN POLLUTION CONTROL SYSTEM

- The ocean pollution control system is based on the following key principles:
  - Monitor the dynamics of seawater pollution levels by conducting long-term systematic observations of background concentrations of pollutants in areas far from the source of pollution. Such observations are held on a limited number of base stations (6 - 10 in the ocean, 2 - 3 in the sea).

## OCEAN POLLUTION CONTROL SYSTEM

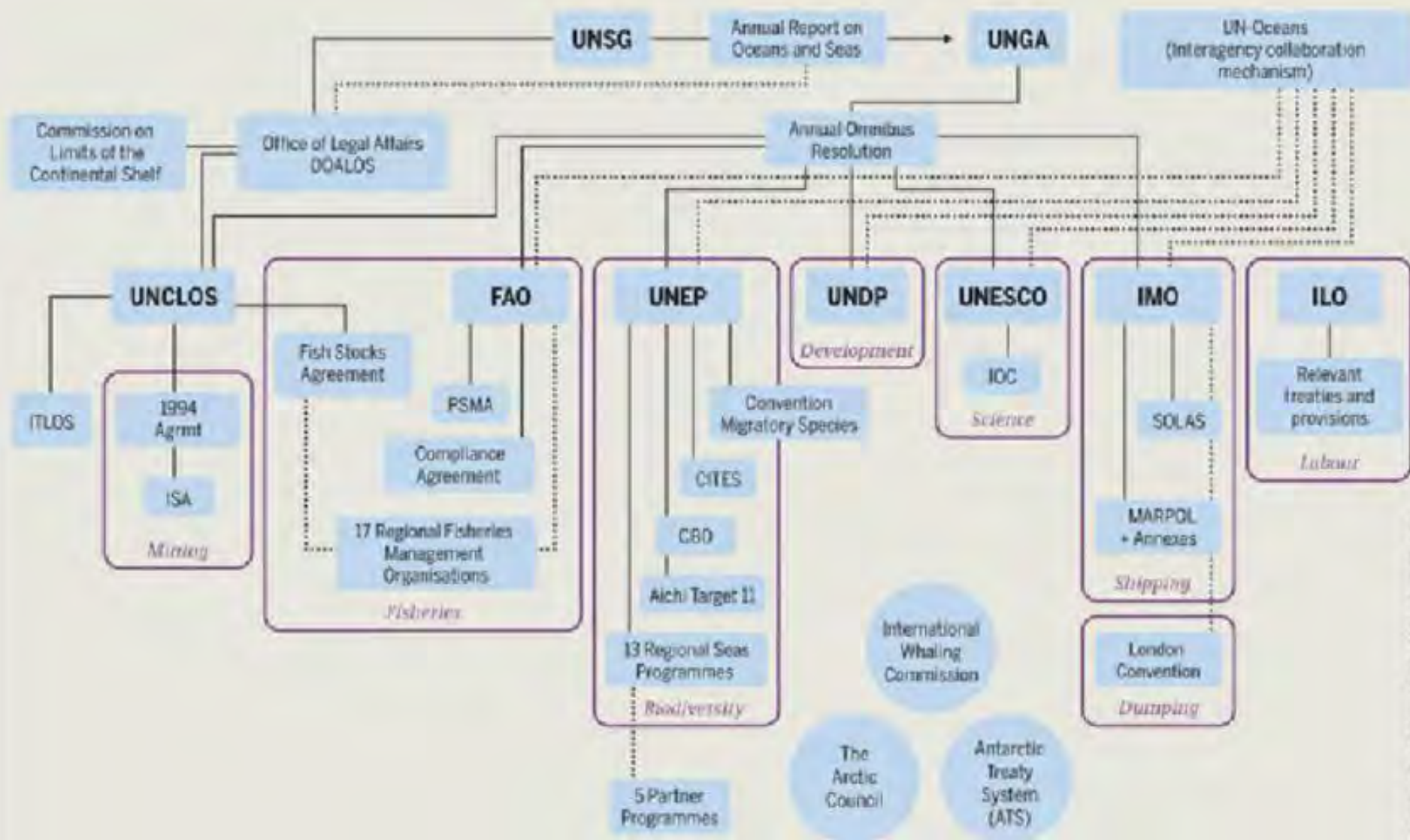
- Monitoring the transport of pollutants through observatories at oceanographic profiles in the major circulation systems of the World Oceans.
- Combining geochemical control of ocean water pollution with biological control of pollution effects on marine life.





Program for Integrated Global Control of the Oceans (Izrael, Shiban, 1986)





## International governance structures for the ocean



# Protect the marine environment from ocean pollution

- Up to now, there have been many international and national laws being studied and implemented to protect and preserve the marine environment - the green lung of the earth.
- To prevent and detained marine pollution, it is possible to apply advanced technologies, clean technologies, cleaner production to exploit marine resources.

# Protecting the marine environment in ship operation

- Ship exploitation activities bring huge sources of pollution into the marine environment, which can be mentioned: oil pollution (from oil used as fuel, lubricant, hydraulics for ships, to cargo oil transported by ships); Pollution due to liquid chemicals carried in bulk on ships.
- Pollution caused by dangerous goods (explosives, radioactive substances, combustibles, poisons, etc.) transported by ships; pollution due to waste; pollution caused by wastewater; air pollution (ozone depleting substances, sulfur oxides, nitrous oxides, carbon oxides, vapors of organic compounds transported on board ships, incineration of wastes on board ships) ;

# Protecting the marine environment in ship operation

- Pollution caused by antifouling paint used for hull; pollution due to toxic materials used in shipbuilding (asbestos, heavy metals, chemicals); pollution caused by the movement of aquatic species through ballast water; infectious diseases transmitted by maritime routes; pollution caused by the demolition of old ships; pollution caused by oil and gas exploration and exploitation activities at sea.

**Thus, the task of environmental protection in this case is to not exceed the permissible pollution level. This is solved in two directions:**

- ❑ Build closed-cycle systems that reuse a major amount of waste;
- ❑ Clean up and reduce the toxicity of waste that inevitably enters the marine environment

**On ships, three main methods of wastewater purification are used:**

- ❑ Biological method, based on biochemical oxidation of wastes by activated sludge; guarantees a high level of cleaning from suspended matter and a significant reduction in BOD, full automation and cleaning of large volumes of wastewater, a high degree of organic matter decomposition and a small amount of residue;
- ❑ Physical methods, including filtration, centrifugation, separation, deposition, etc.
- ❑ The physicochemical method ensures the solidification, adsorption and oxidation of fine particles in wastewater



# Homework

1) What is Marine pollution control system?

What elements does the marine pollution control system include?

2) Analysis of Marine Pollution Geochemical and Biochemical Control System.