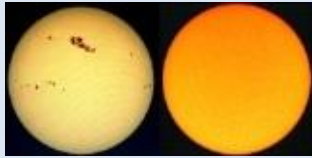
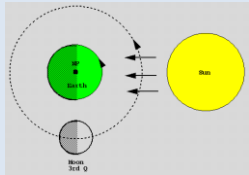


# The Functioning of Marine Ecosystems

## Four major Elements



11-year cycle



18-year cycle



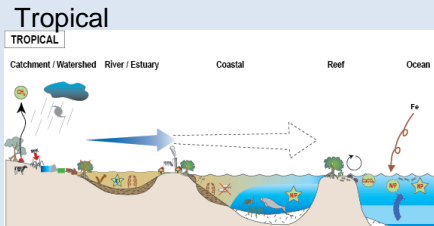
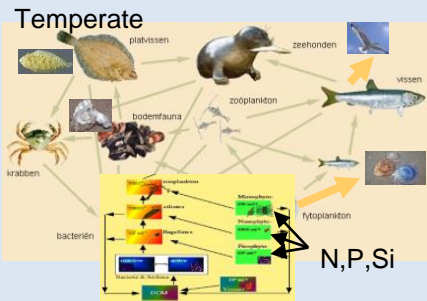
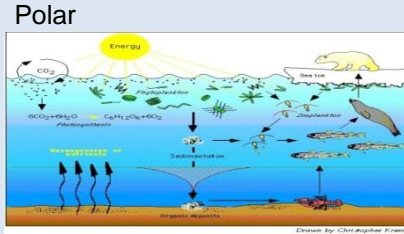
Setting the stage

**Habitat**

(Intrinsic properties non-living nature)



**Energy**  
Natural driver of change



**Man**  
Man-made drivers of change

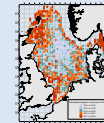
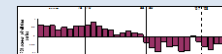


**Anthropocene**



Determines reaction

**Intrinsic properties living nature**



# The Functioning of Marine Ecosystems

Man

## Four major Elements

### Energy

Sun/moon  
(Light/heat/kinetic)

### Climate

Temperature  
Wind  
Precipitation  
Tides/Currents

### Nutrient availability

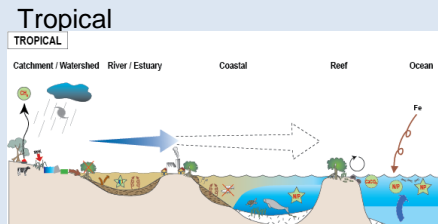
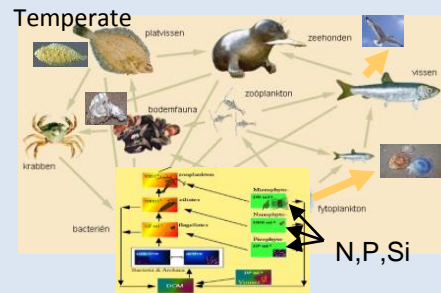
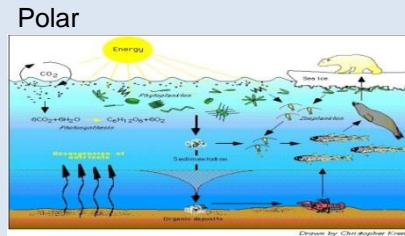
### Tectonics

Volcanism  
Earth quakes  
Tsunamis

### Habitat

(*Intrinsic properties  
non-living nature*)

Depth  
Bottom type  
Currents  
Salinity  
Waves (*splash zone*)  
Hydrothermal vents  
Gas seeps  
Ice  
Biogenic structures  
Man-made structures



### Pressures

Extraction  
    living and  
    non-living  
Physical loss  
Siltation  
Abrasion  
Nutrient enrichment  
Noise  
Temperature  
Salinity  
Contamination  
Introduction  
    non-indigenous sp.  
Habitat changes  
pH changes  
Collisions

### Activities

Fisheries  
Hunting  
Aquaculture  
Nutrient inputs  
Shipping  
Tourism  
Mining  
Military  
River inputs  
Constructions  
Energy production  
Dredging  
CO<sub>2</sub> emissions

### Intrinsic properties living nature

#### Features

Biodiversity  
Behavior  
Production  
Recruitment  
Predation  
Diseases  
Reef building

#### Processes

Evolution  
Regime shifts/sudden  
changes  
Resilience/sensitivity  
Feedbacks  
Match/mismatch

Complexity/chaos

# The Functioning of Marine Ecosystems

## Four major Elements

### Wadden Sea, NL

#### Energy

Sun/moon  
(Light/heat/kinetic)

Climate

Temperature

Wind

Precipitation

Tides/Currents

Nutrient availability

Tectonics

Volcanism

Earth quakes

Tsunamis

#### Habitat

(Intrinsic properties  
non-living nature)

Depth

Bottom type

Currents

Salinity

Waves (splash zone)

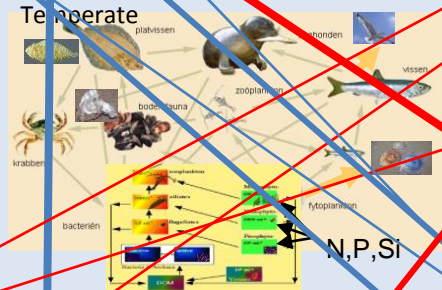
Hydrothermal vents

Gas seeps

Ice

Biogenic structures

Man-made structures



#### Man

Fisheries

Hunting

Aquaculture

Marine pollution

Eutrophication

Noise

Invasive species

Shipping

Tourism

Mining

River inputs

Constructions

Hard substrate

Dredging

Rotor blades

CO<sub>2</sub> emissions (climate and acidification)

#### Intrinsic properties living nature

Features

Biodiversity

Behavior

Production

Recruitment

Predation

Diseases

Reef building

Processes

Evolution

Regime shifts/sudden

changes

Resilience/sensitivity

Feedbacks

Match/mismatch

Complexity/chaos



#### Anthropocene

