Colloquium on the Millenium Ecosystem Assessment

Brussels, 27th October 2006

# Marine and coastal ecosystems
## The Belgian coastal zone

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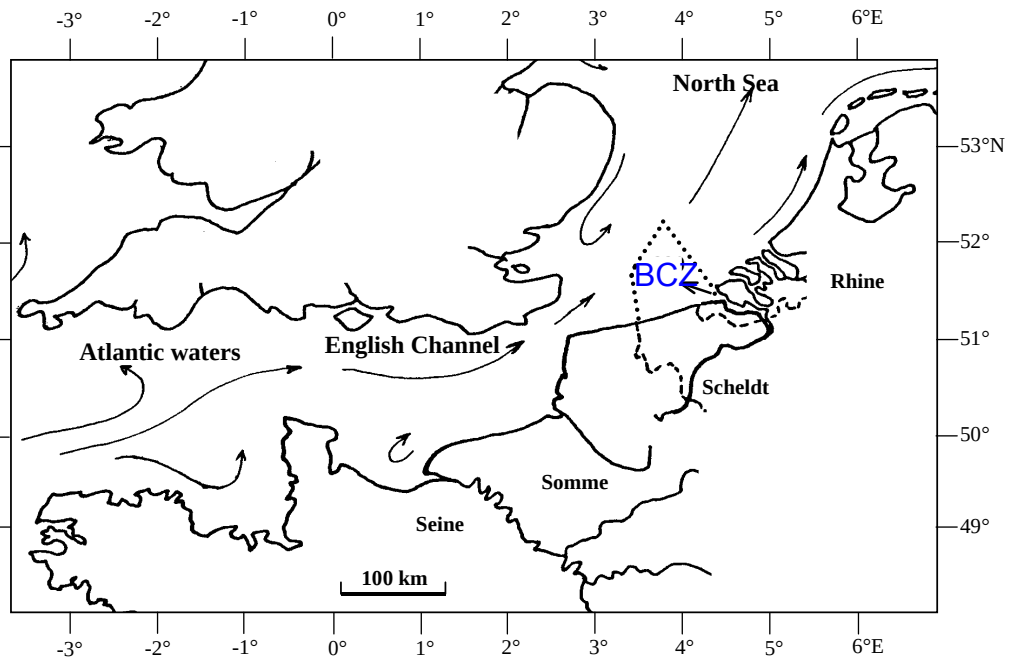
# The Belgian coastal zone (BCZ): at the interface between land and ocean




## Drivers of changes:

Indirect: population growth
economy
Science and technology
governance (e.g. WFD)

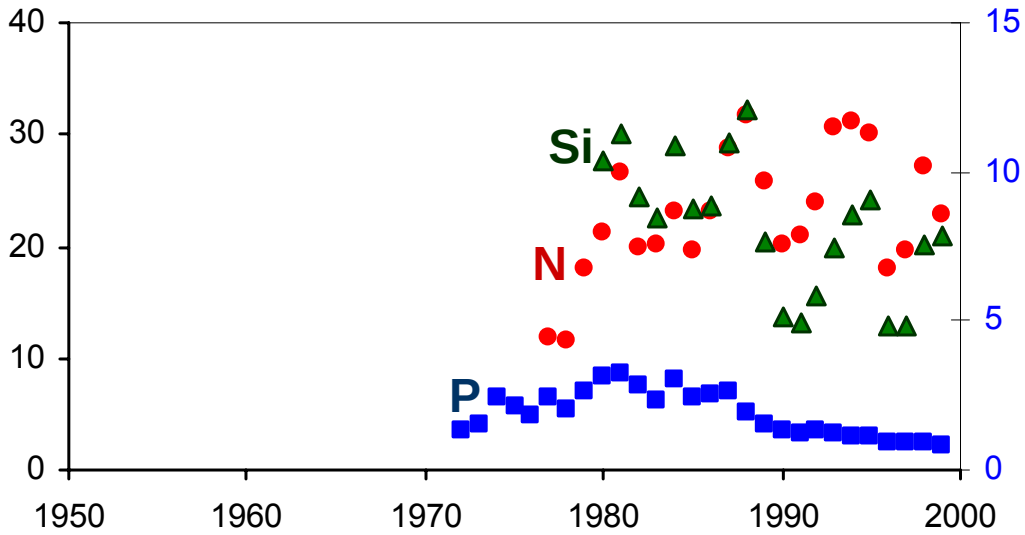
Direct: nutrient loads (eutrophication)
fishing pressure
aquaculture

## MA "Ecosystem goods and services" :

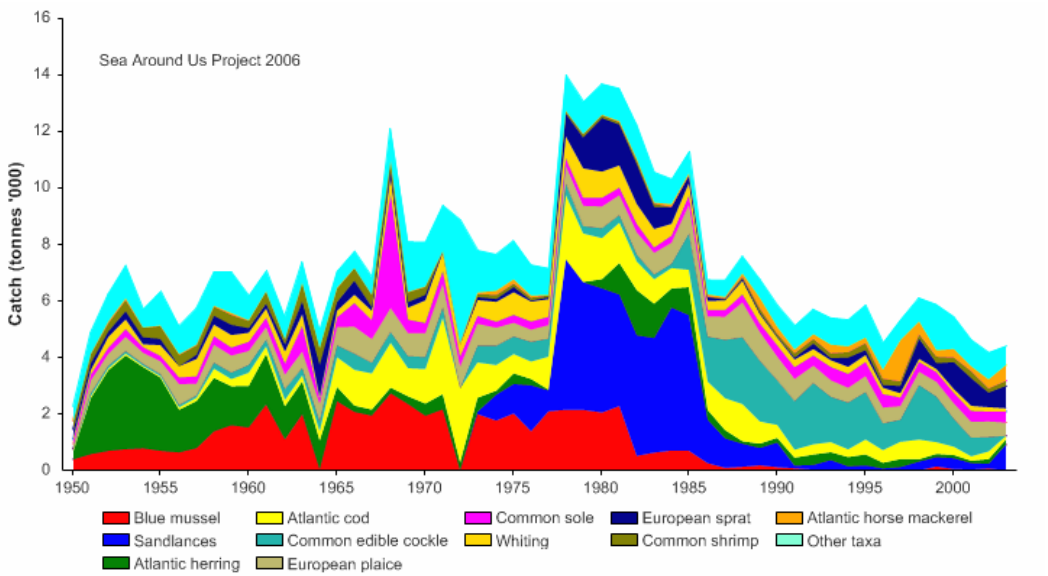
- Biodiversity
- Provider of food (fisheries and aquaculture)
- Support of primary production and nutrient cycles
- Regulator of climate (sink/source of atm $CO_2$)
- Aesthetic, recreational and cultural value

# Human perturbations of the BCZ ecosystem since 1950

Scheldt nutrient loads, kt $y^{-1}$
Rousseau et al., 2004




Catches per species
http://seaaroundus.org/



# BCZ ecosystem response to perturbations

Non-perturbated food web

Nutrients
N, P
Si

phytoplankton

zooplankton

Planktivorous fish

Piscivorous fish

Eutrophication

Overfishing

Nutrients
**N, P**
Si

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\+

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Ungrazed *Phaeocystis* colonies
[Diameter >400µm]

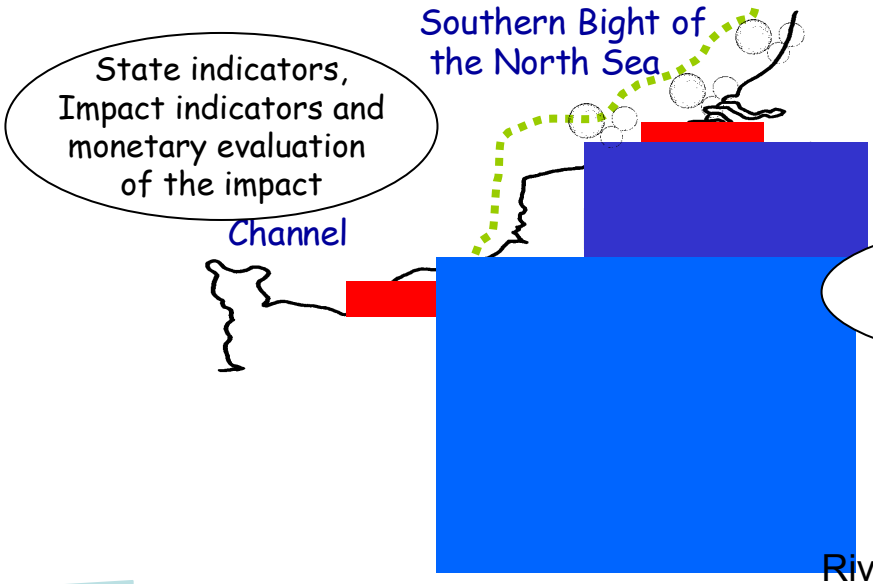
# Millenium Assessment Research Needs for BCZ:

- Analytical tools for:
  - assessing past trends (-50 years),
  - projecting future trends (+50 years) of ecosystem state and services,
  - evaluating the success of interventions
- Indicators to define ecological quality objectives (EQO) and monitor ecological and social changes

Interdisciplinary research

The impact pathway methodology developed by ULB-UPMC to mitigate eutrophication in BCZ

# The ULB-UPMC methodological approach to mitigate eutrophication in BCZ: the river-sea continuum




River-sea continuum

**VALUATION** Economic Analysis

**IMPACTS**

**Indirect** Economic impacts identification

**Direct** Coastal ecosystem Model &EQO

**Nutrient TRANSPORT** River ecosystem model

**Nutrient EMISSIONS** Agriculture + wastewater

CVM & market-based methods

economic activities

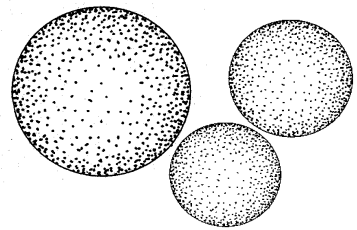
**MIRO** model

**RIVERSTRAHLER** model

**Coupled mathematical model**

Physical emissions

mitigation costs



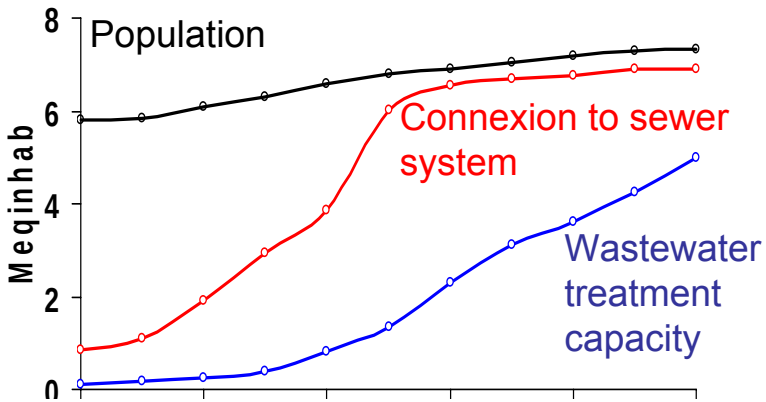
# 1-BCZ ecosystem change over the last 50 years

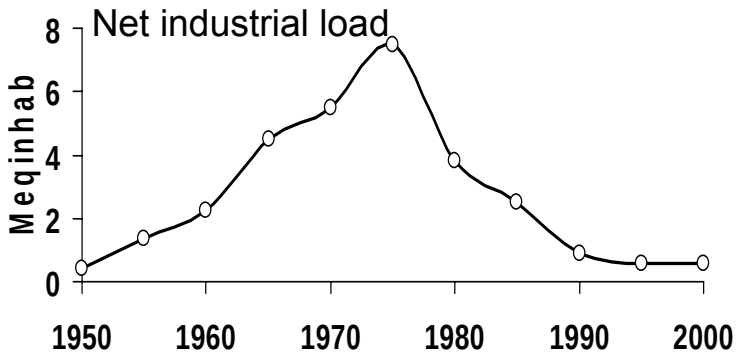
- Reconstruction of nutrient emissions data
- Application of the coupled RIVERSTRAHLER-MIRO model
- EQO for *Phaeocystis* based on maximum grazable colony size (diameter: 400 µm) and field records: 150 mgC $m^{-3}$

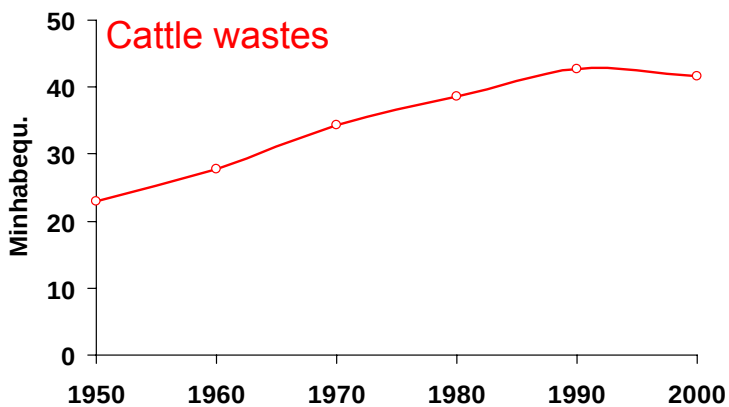
# Changing nutrient delivery to BCZ over the last 50 years

Billen et al. 2005

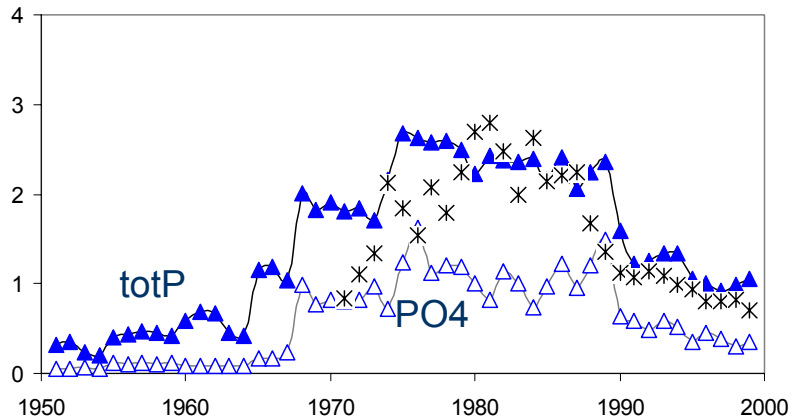
## Drivers: Scheldt watershed

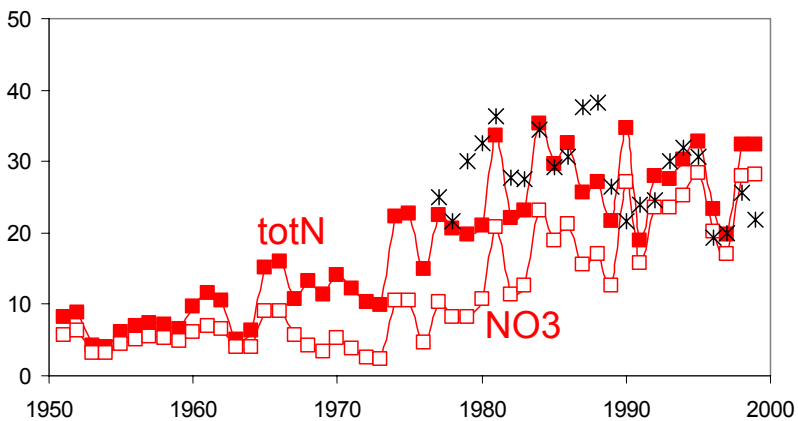


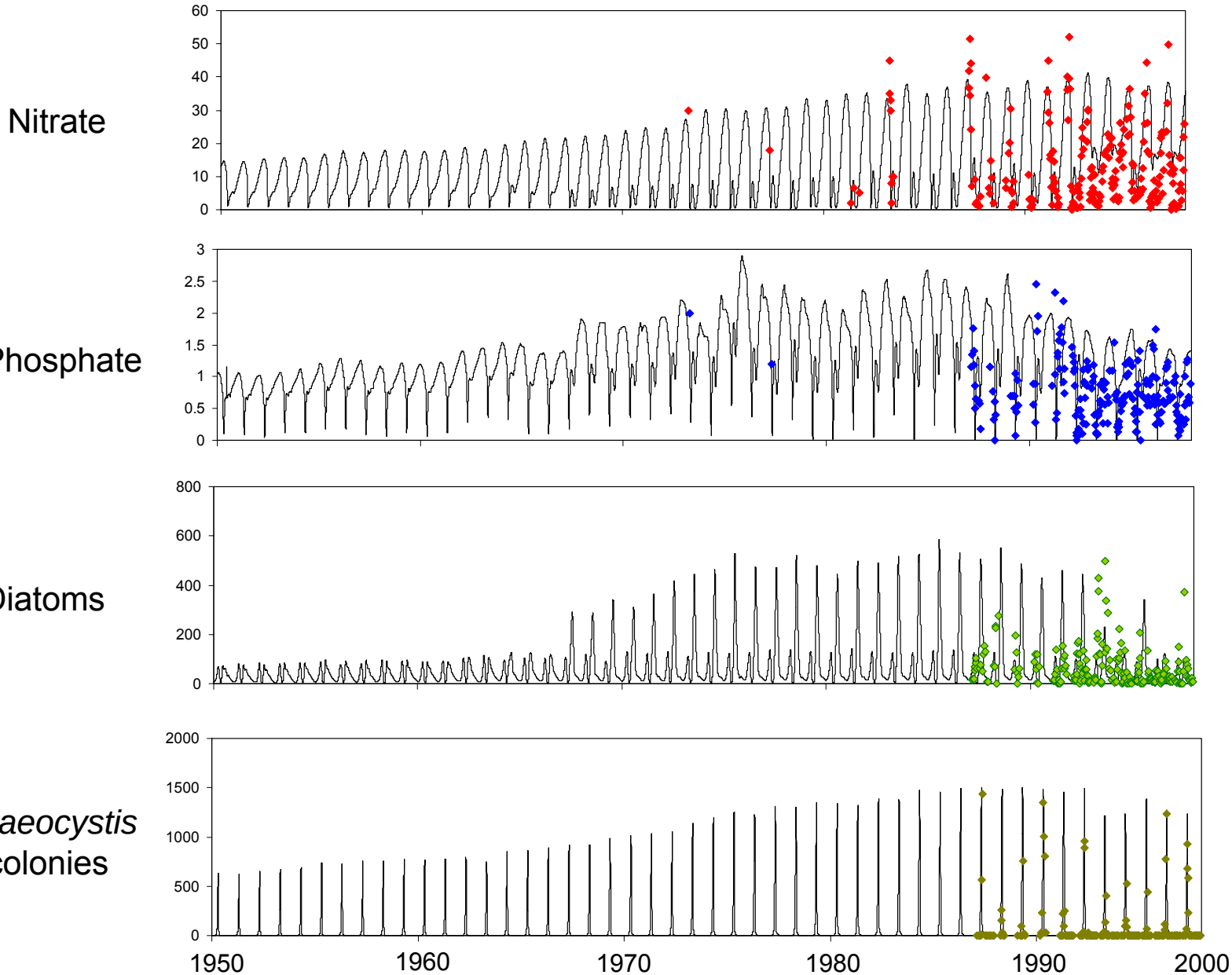

## Scheldt inputs to BCZ, kt year$^{-1}$



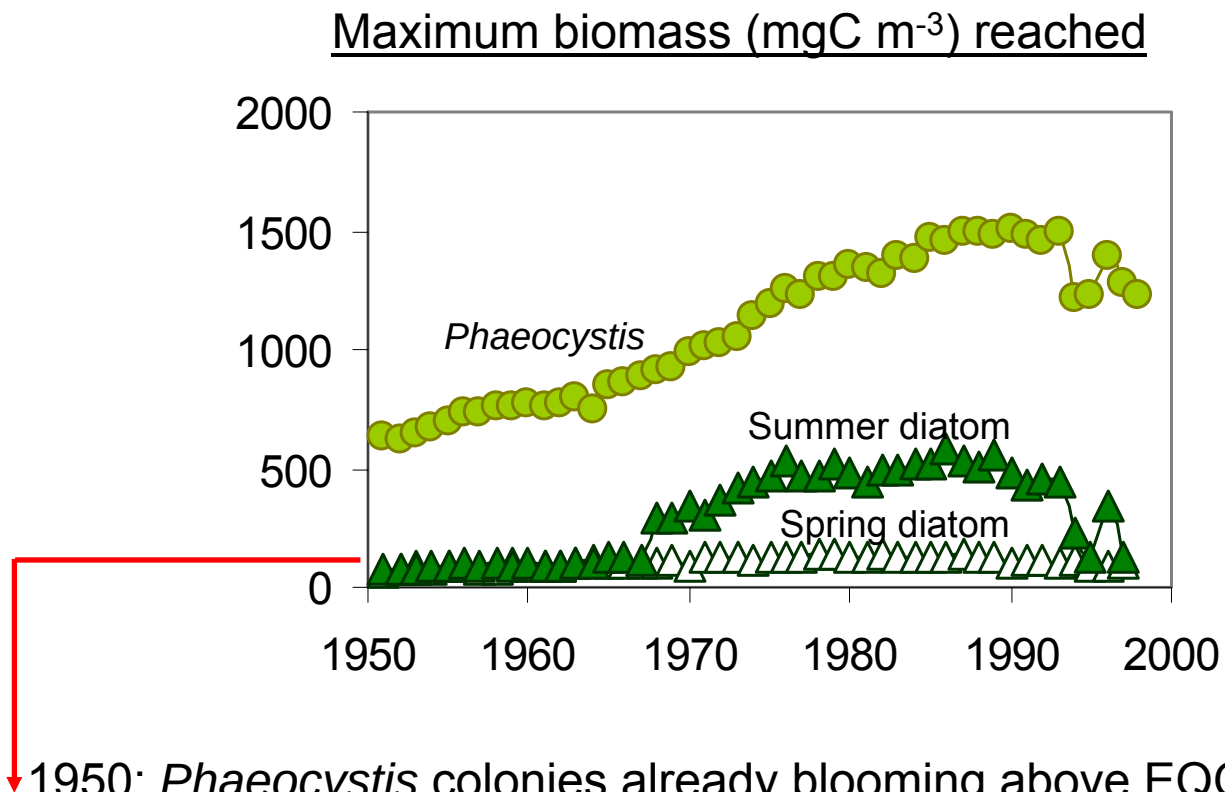



# BCZ ecosystem response since 1950: nutrients and blooms

Lancelot et al., 2006



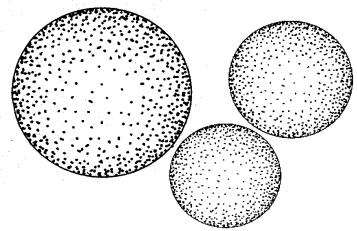
# BCZ ecosystem response: ecological analysis




1950: *Phaeocystis* colonies already blooming above EQO

1960-1989: increase of both N and P loads was beneficial to both *Phaeocystis* and summer diatoms

Since 1989: decrease of P but maintenance of elevated N loads → decrease of siatom summer blooms but little effect on *Phaeocystis*. The latter was controlled by N loads

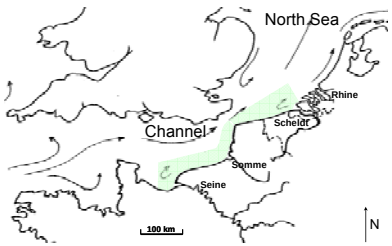


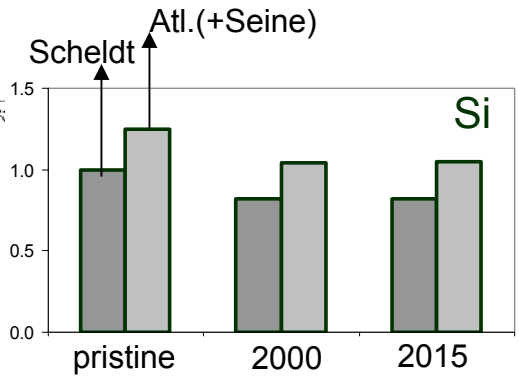
# 2-Future trends in BCZ ecosystem: Scenario building

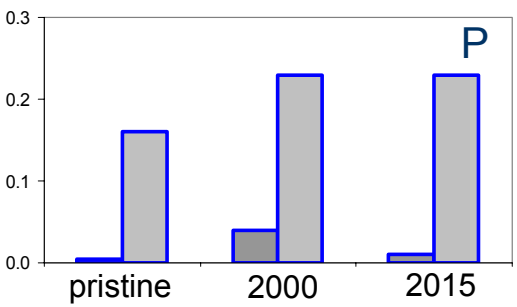
- Ecological trends: use of the coupled RIVERSTRAHLER-MIRO model:
  i. Scenario 2015 (Implementation of the EU WFD)
  ii. Scenario “pristine”: historical background
- Socio-economic analysis
  i. Nutrient mitigation measures and costs (cost-effectiveness modelling and analysis)
  ii. Economic evaluation (cost-benefit analysis)

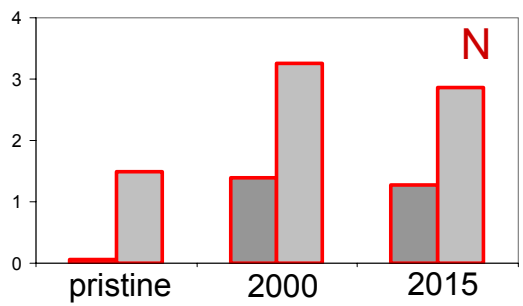
# Future ecological trends in BCZ: 2015

Nutrient inputs,Kt $y^{-1}$

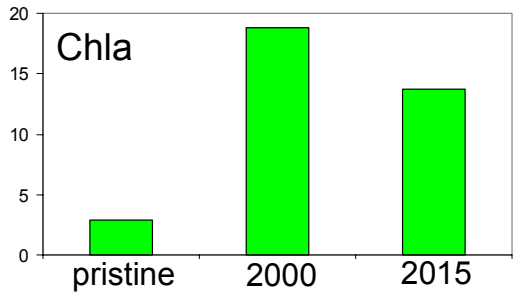


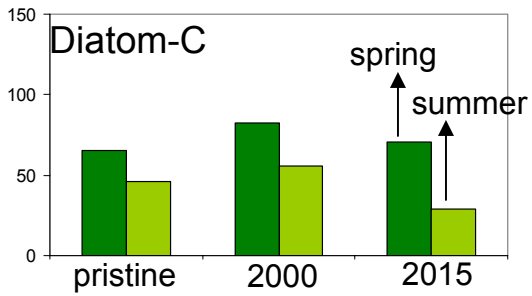



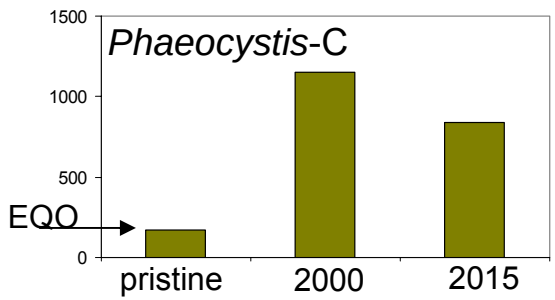




Phytoplankton max, mg $m^{-3}$




Decrease of *Phaeocystis* blooms needs decrease of N inputs by both the Seine and Scheldt

# Socio-economic analysis

- Nutrient mitigation measures and costs
  - Waste water treatment facility (upgrading and construction)
  - -Reduction of fertilizer use
  - -Wetlands creation or restoration

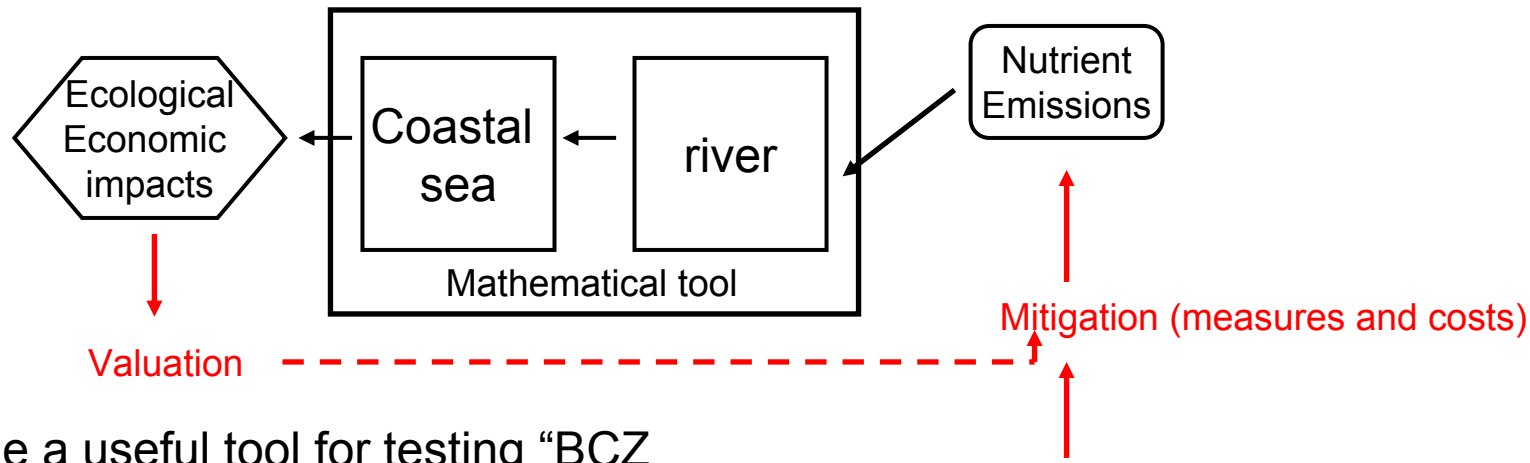
- Identification and valuation of economic impacts
  - Use value: direct *e.g. I can go swim*
    indirect *e.g. it produces fish that I eat*
    optional *e.g. it may have future use that I don't know yet*
  - Non-use value: existence *e.g. I like knowing it exists even if I may never come back again*
    bequest *e.g. It is part of the world I want to leave to my children and their children*

Examples:

| **Impact** | **Type of value** | **Method** |
|---|---|---|
| Fisheries<br>Recreational activities (foam) | Indirect use<br>Direct use | Market<br>Contingent valuation |

# Conclusions and further work

The ecosystem assessment methodology developed by ULB-UPMC:




Provide a useful tool for testing "BCZ ecosystem" improvements obtained by implementation of the four MA scenarios for mitigation of nutrient emissions in France and Belgium:

- Global Orchestration
- Order from Strength
- Adapting Mosaic
- Techno-Garden

Additional drivers to be considered:

- overfishing
- climate change

Acknowledgements:

Belgian Federal Science Policy: Project AMORE (Advanced Modeling Research on Eutrophication)

European Commission FP6: IP THRESHOLDS