Achievement of a good chemical and ecological status :
Existing challenges and a way forward to improve the risk assessment strategies

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What is the problem?

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Several regulations of chemicals in waters : a paradox.

- REACH and 94/414 regulate the use of chemicals
- WFD/chemical quality : prohibits that 33 substances being over water quality standards
- WFD/ecological status : prohibits that water bodies might be lower than good status
- Effluent release in the environment is controled, using chemical analyses and whole effluent toxicity tests in several EU countries
- How can any chemical survive such a hunt?

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However reality is quite sad!

- Many chemicals are present in waters in toxic concentrations
- Exemple: Pesticides in France (75% of waters contaminated)
- Nitrate and phosphorus remains high in many water bodies
- Sexual modifications can be recorded in fish
- In 2007 a new list of 8 substances was added to the initial 33 substances list
  - And other will come

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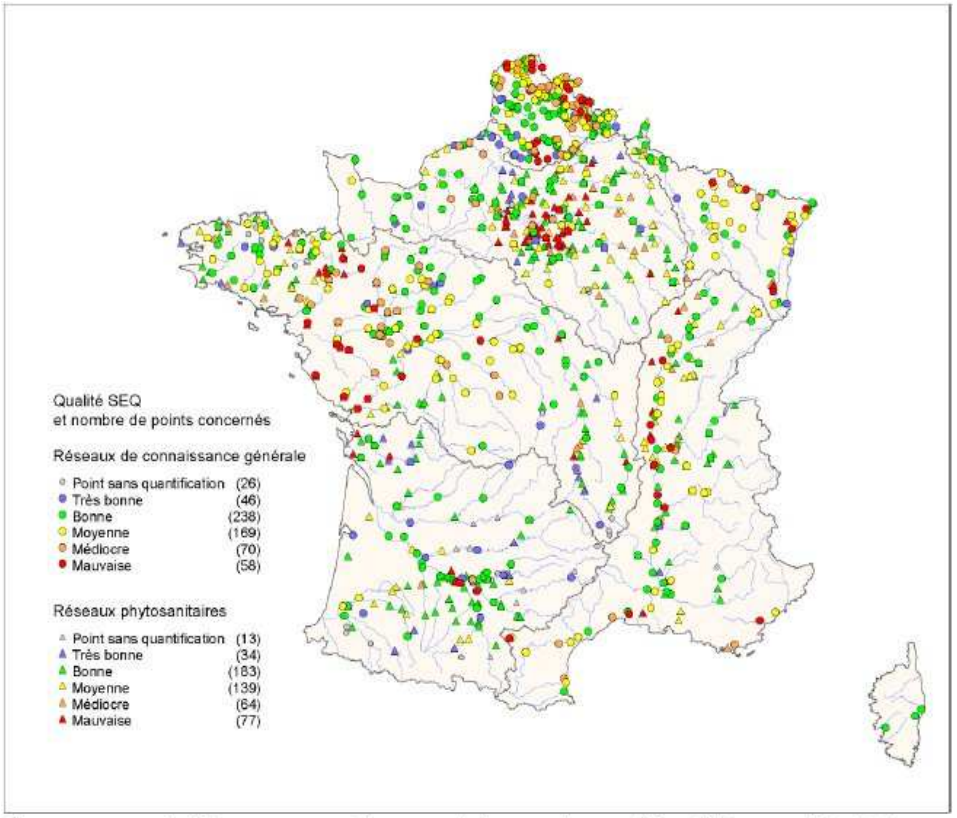
Pesticides In French waters

2004 : 75% contaminated



Source : agences de l'Eau et groupes régionaux sanitaires – traitements Ifen : SEQ-eau qualité globale eaux

	Points interprétables	Points sans quantification	Points quantifiés en qualité :				
			Très bonne	Bonne	Moyenne	Médiocre	Mauvaise
2003	493	8	35	206	141	42	61
2004	607	26	46	238	169	70	58

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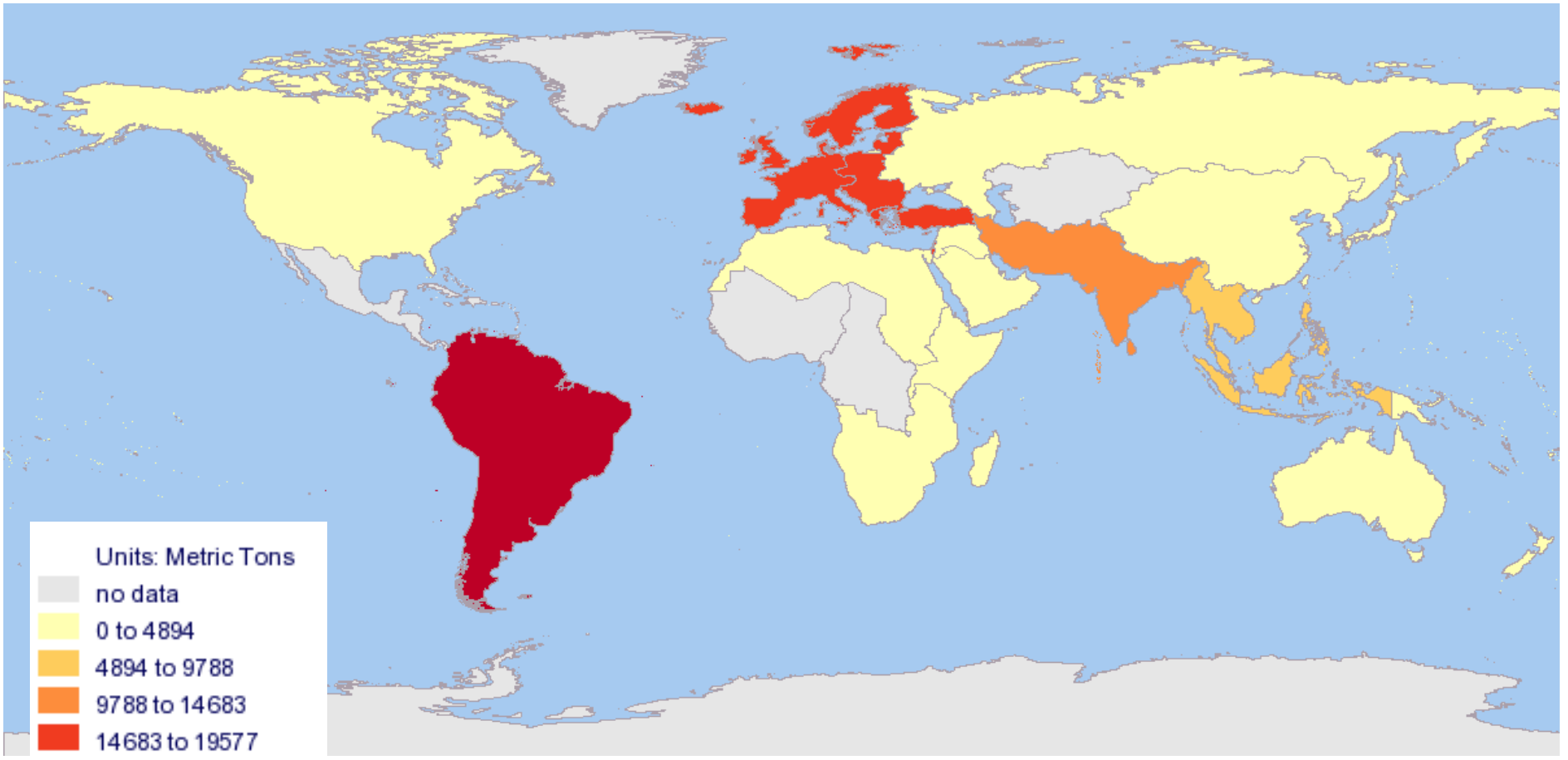
Insecticides consumption



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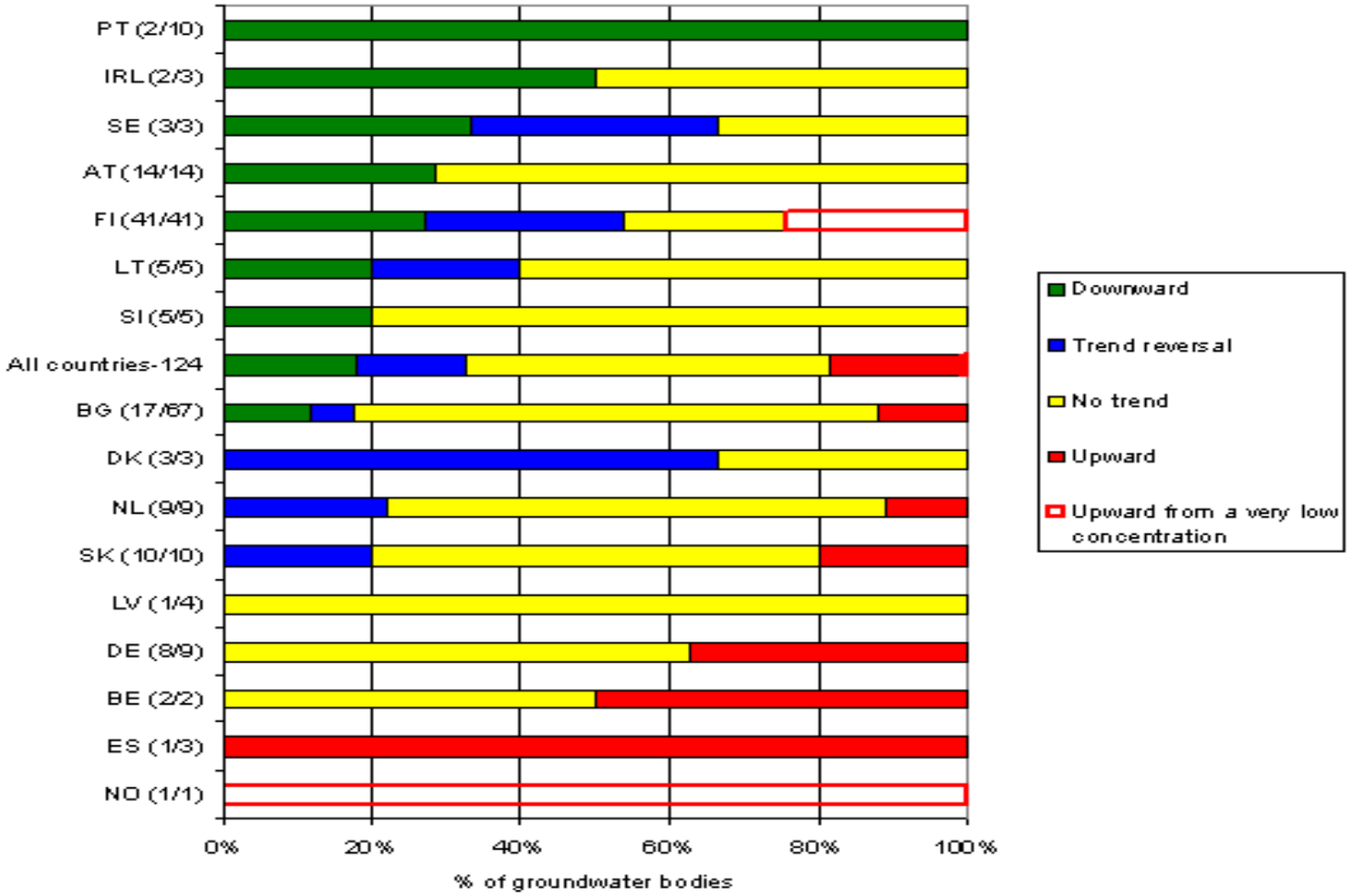
Trends in nitrate concentration in Europe



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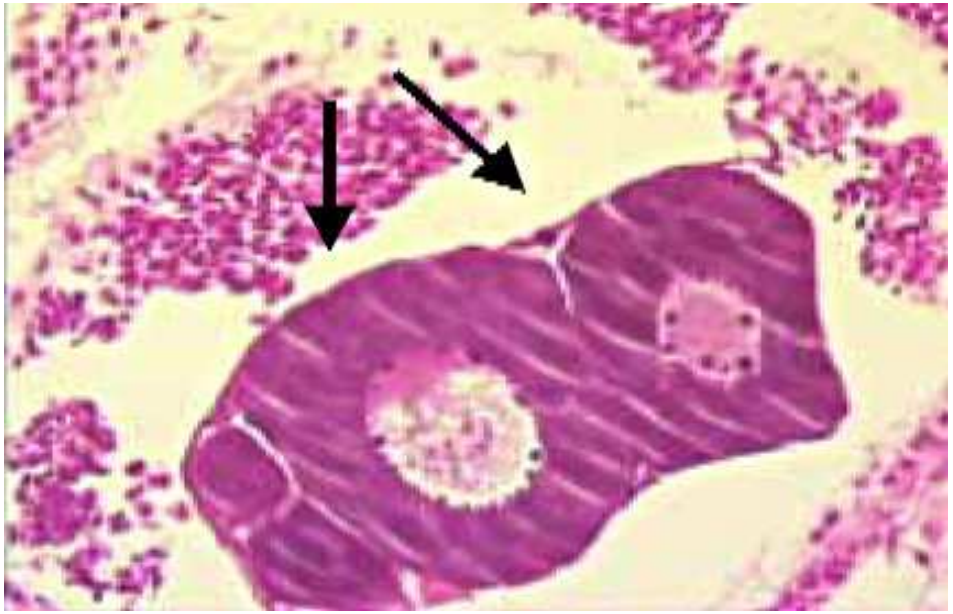
Hormone effects in fish

- **What are the right markers?**
- **Which substances are responsible?**



Histological view of a gonad from a chub downstream Lyons (Flammarion et Al.)

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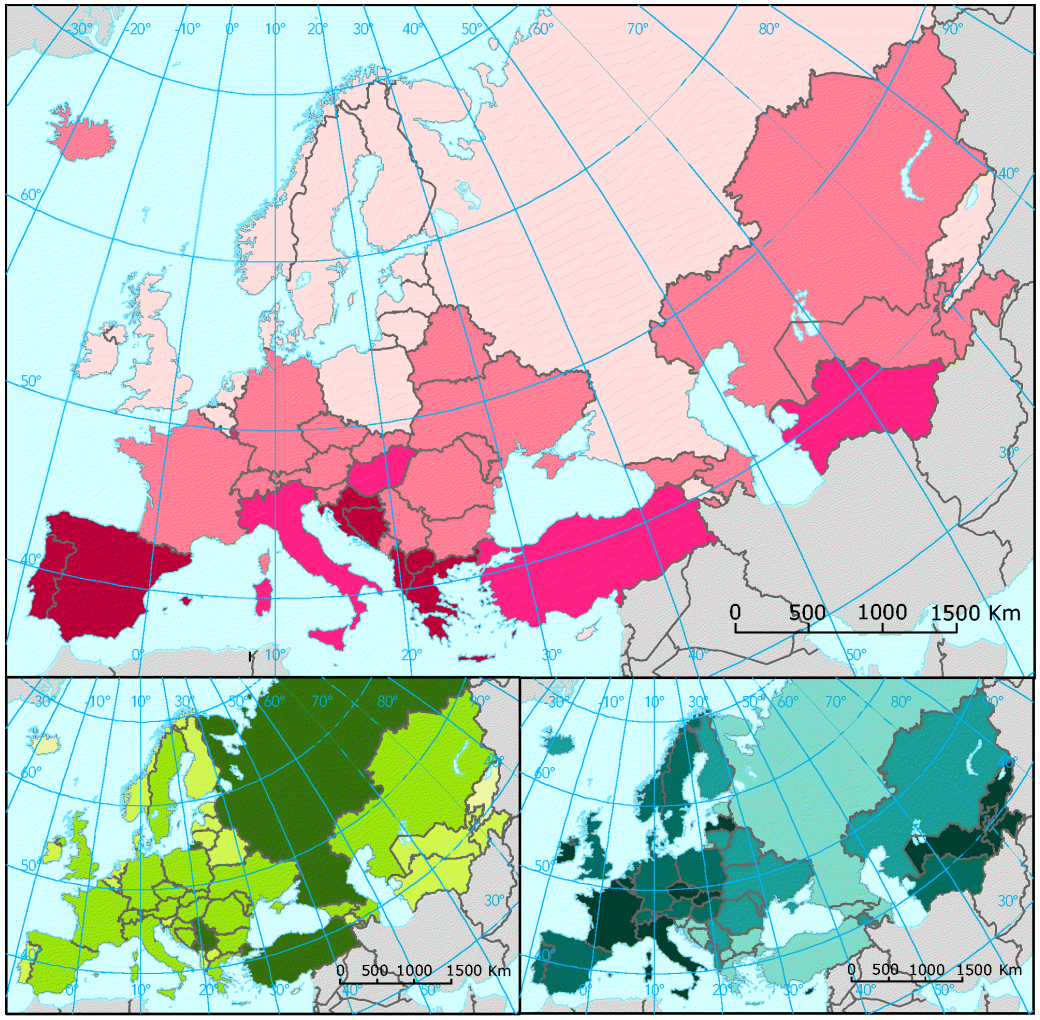
Threatened fish in EU waters



Share of globally threatened species in native freshwater fish

%
- 0–7
- 8–15
- 16–30
- 31–44

Number of species
- 0–25
- 26–50
- 51–100
- 101–344

Introduced species

%
- 0–11
- 12–20
- 21–29
- 30–69

Outside report coverage

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Sea pollution over the world

Polluted Seas

Major Bodies of Water/Areas with Serious Water Pollution Problems

Body of Water	Microbiological	Eutrophication	Chemical	Suspended solids	Solid wastes	Thermal	Radionuclides	Spills
Gulf of Mexico	Severe Impact	Moderate Impact	Moderate Impact	Moderate Impact	Moderate Impact	No known impact	No known impact	Slight Impact
Caribbean Sea	Moderate Impact	Moderate Impact	Moderate Impact	Severe Impact	Moderate Impact	Slight Impact	Slight Impact	Severe Impact
Baltic Sea	Slight Impact	Severe Impact	Moderate Impact	Slight Impact	Slight Impact	No known impact	Slight Impact	Moderate Impact
Aral Sea	Slight Impact	Severe Impact	Severe Impact	Severe Impact	Moderate Impact	Slight Impact	Slight Impact	Slight Impact
Yellow Sea	Moderate Impact	Severe Impact	Slight Impact	Slight Impact	Moderate Impact	Slight Impact	No known impact	Moderate Impact
Bohal Sea	Moderate Impact	Severe Impact	Moderate Impact	Slight Impact	Moderate Impact	Slight Impact	No known impact	Severe Impact
Congo Basin	Moderate Impact	Severe Impact	Moderate Impact	Moderate Impact	Severe Impact	No known impact	No known impact	Moderate Impact
Benguela Current	Moderate Impact	Moderate Impact	Severe Impact	Moderate Impact	Severe Impact	Slight Impact	Severe Impact	Severe Impact
Lake Victoria	Severe Impact	Severe Impact	Moderate Impact	Severe Impact	Slight Impact	No known impact	No known impact	No known impact
Pacific Islands	Moderate Impact	Slight Impact	Moderate Impact	Moderate Impact	Severe Impact	Slight Impact	Severe Impact	Slight Impact

SOURCE: Adapted from UNEP SEO Report 2004-2005

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Some scientific issues

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Problems with risk assessment of chemicals

- PNEC is not based on a reasonable excess risk value : build on NOECs that are close to 10% effect
- No assessment at the community level, apart from studies on some pesticides
- Variability only addressed using safety factors
- Most statistics are disputable (Hypothesis testing at low power)
- Fate of chemicals is not georeferenced
- Degradation processes are weakly known
- And all uncertainty and variability is confounded within arbitrary safety factors

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How is PNEC determined?

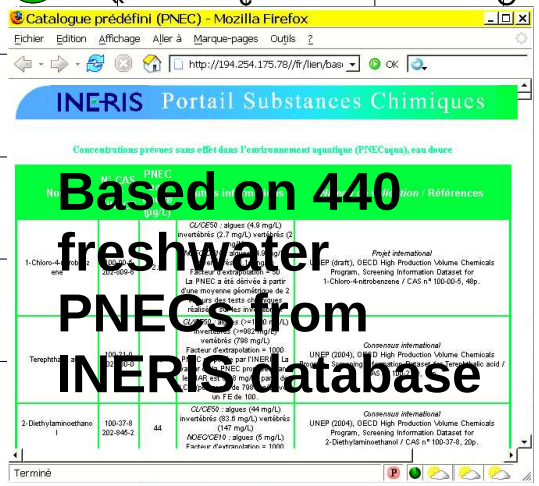
Lg PNEC

Lg lowest NOEC/EC$_{10}$

Correlation coefficients

	PNEC	TOX
TOX	0,88	1
Safety factor	0,18	0,53

Safety factors are still a relevant « explanation » for PNEC!



Based on 440 freshwater PNECs from INERIS database

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What needs to be clarified on the exposure side?

- **Sources of pollution**
  - That is where scientists should insist on PMs to get data, without any belief in confidentiality argument
- **Fate of chemicals**
  - Transformations
  - Degradation
  - Change of compartment (volatilisation, precipitation…)
- **Localisation of chemicals in the environment**
  - From an ecosystem point of view
  - From a human health point fo view with focus on sensitive populations

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Interactions

- **Interactions between chemicals**
  - **Reactivity of chemicals interacting within biotopes**
  - **Joint effects at organism or sub-organism level**
  - **Interaction of effects of different chemicals with different species within communities**
- **The number of possible combinations is terrific**
  - **No *a priori* statistical solution**
  - **Science needs to understand mechanisms at those levels and to model them**
- **Interaction between anthopogenic pressures**
  - **Pathology of stressed species, Immuno-depression**
  - **Multiple stresses on major physiological functions**
  - **Microbial, algal, fungal or viral blooms**

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Chemicals in the environment : 3 M Mechanisms, Medias, Models

- **Mechanisms**
  - Need to understand what happens at different levels from microscopic to macroscopic
  - Globally increase toxicological knowledge
  - Specifically increase knowledge of cancer and reproduction
- **Medias**
  - Exposure can only be understood if the complex relationships between medias, communities and Man
- **Models**
  - The best way to integrate different observations
  - A validated model adds knowledge to data to build information
  - No modelling leads to no prediction and so no prevention

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Biomarkers

- On a theoretical point of view biomarkers have several advantages :
  - Integrate exposure(s) with time
  - Take bioavailability in consideration
  - Use biological effects rather than exposure only
- Why is their use not that much developped
  - Regulators do not understand really what it means
  - Identification of substances is prefered to effects
  - Few labs know how to measure them
- They should be seriously considered in the future
  - For their own advantages
  - But also since new (...omics) tools appear

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Develop QSAR modeling

- Chemical structure contains all the information that determines activity, properties, toxicity…But
  - We are lacking most of this knowledge
  - we do not know how to use the information we have!
  - In most cases knowledge about biological properties still needs to be embedded within models
- Environmental observation is also a large source of information… But :
  - It is diffuse and heterogenous
  - We not only need to observe we need to predict
- Models:
  - extract information from chemical structure,
  - create knowledge from this info,
  - Include knowledge of what happens in the real world,
  - Include this knowledge in models

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Main R&D issues from a policy maker's perspective

- Assimilation of data from different origins
  - To refine exposition assessment by using local geophysical parameters
  - To check the adequacy of models
  - To have real time situation assessment
  - To assess exposition of real populations
- Knowledge of degradation products and the way they are produced
- Better modelling of the fate of chemicals
  - taking into account local parameters
  - Including all relevant knowledge in models
  - As an input to Risk Assessment models

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What are the costs and benefits?

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The first benefit is to avoid costs

- In France the annual budget of cancer from asbestos is 1.1M€
- Asthma and reproduction problems increase in urban/developed world, child cancer increase in some countries, the cost is very difficult to assess but might be considerable
- Some costs are not embedded in economy but are real :
  - Cost of affective lost
  - Lack of confidence in policy making and science
  - Lack of confidence in the future of humanity

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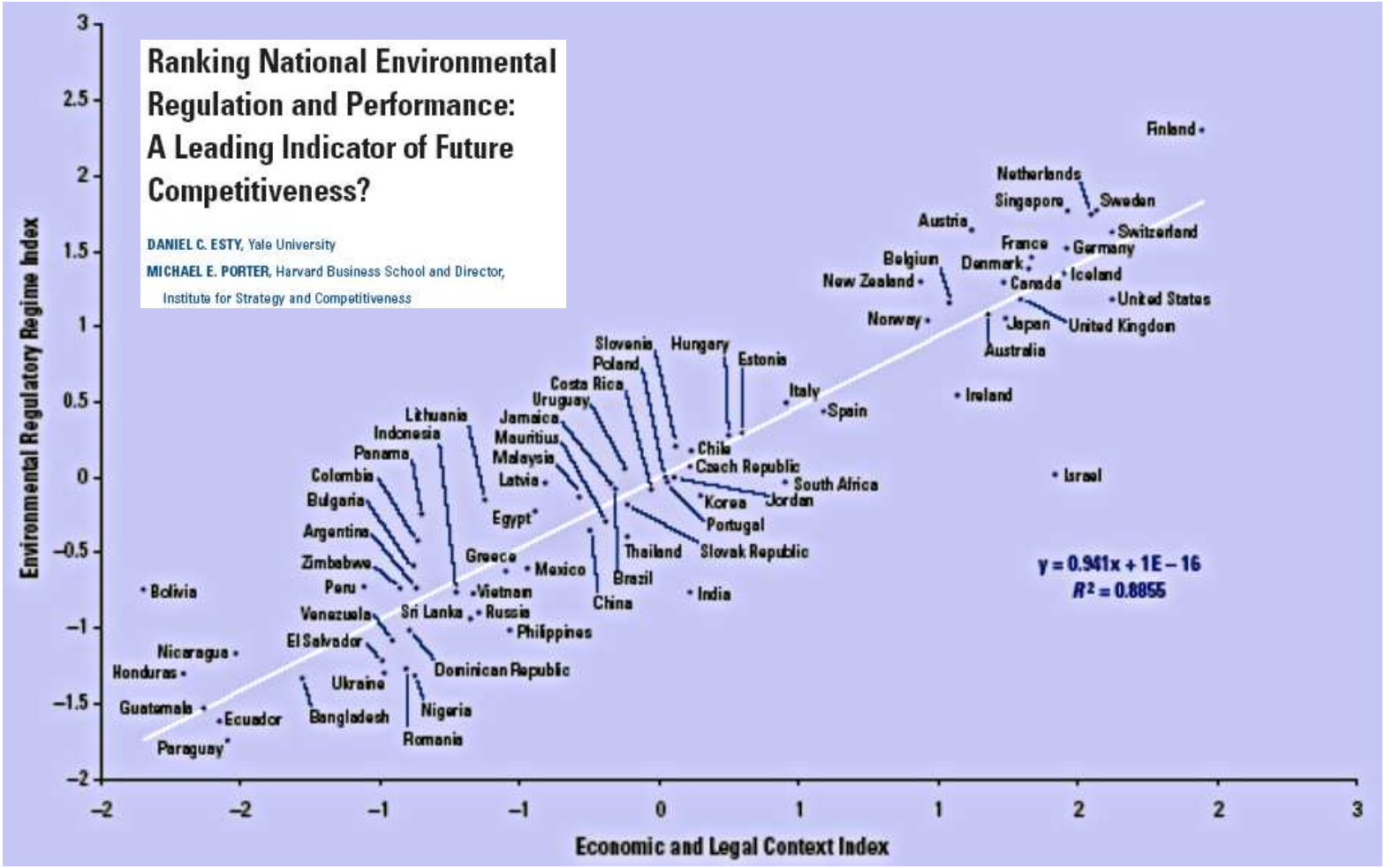
The "cost" of protecting the environment



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The cost is worth spending some money on environmental issues

CHINA **New China Environment Ministry "Lacks Local Powers"**

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UK: March 7, 2008

LONDON - What would it cost to wipe out world poverty, guarantee universal health care, stabilise population growth and roll back the ravages of global warming?

About $190 billion a year, or the equivalent of a third of US annual military expenditure, a prominent environmental economist says in a new book.

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Excerpts from the Millenium Ecosystem Assessment statements

- Everyone in the world depends on nature and ecosystem services...
  - Humans have made unprecedented changes to ecosystems in recent decades...
  - Human activities have taken the planet to the edge of a massive wave of species extinctions...
- The pressures on ecosystems will increase globally in coming decades unless human attitudes and actions change.
- Even today's technology and knowledge can reduce considerably the human impact on ecosystems.
  - They are unlikely to be deployed fully, however, until ecosystem services cease to be perceived as free and limitless, and their full value is taken into account.

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Some policy options

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Why not using economical regulation instruments

- Threshold values in the environment come from a belief in threshold effects
  - It is still necessary as foolguards
  - It will last as long as water quality objectives are overpassed
- Pressures on the environment is in fact a non free use of amenities
  - It is fair to pay taxes to ensure equity towards nature
  - Pollution based taxes are good incentives for a cleaner economy
  - The income can be used for environmental restoration or social improvement (Economists evaluate te cost of restoring planetary environment by 190G$)
- It might help to reduce work based taxes

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How could regulation move towards economical intruments

- Need for a quantitative assessment of the ecological and sanitary impacts of each substance
  - Models that integrate effects at several levels
  - Improvement of the evaluation of fate
- Need to evaluate the value of natural amenities
  - Willingness to pay, hedonic methods, etc should be improved since they overestimate recreation use of the environment
- Change of attitude towards environment
  - Richness of economies is explained by their effciency in using fossil ressources
  - This should be reversed towards eco-efficiency

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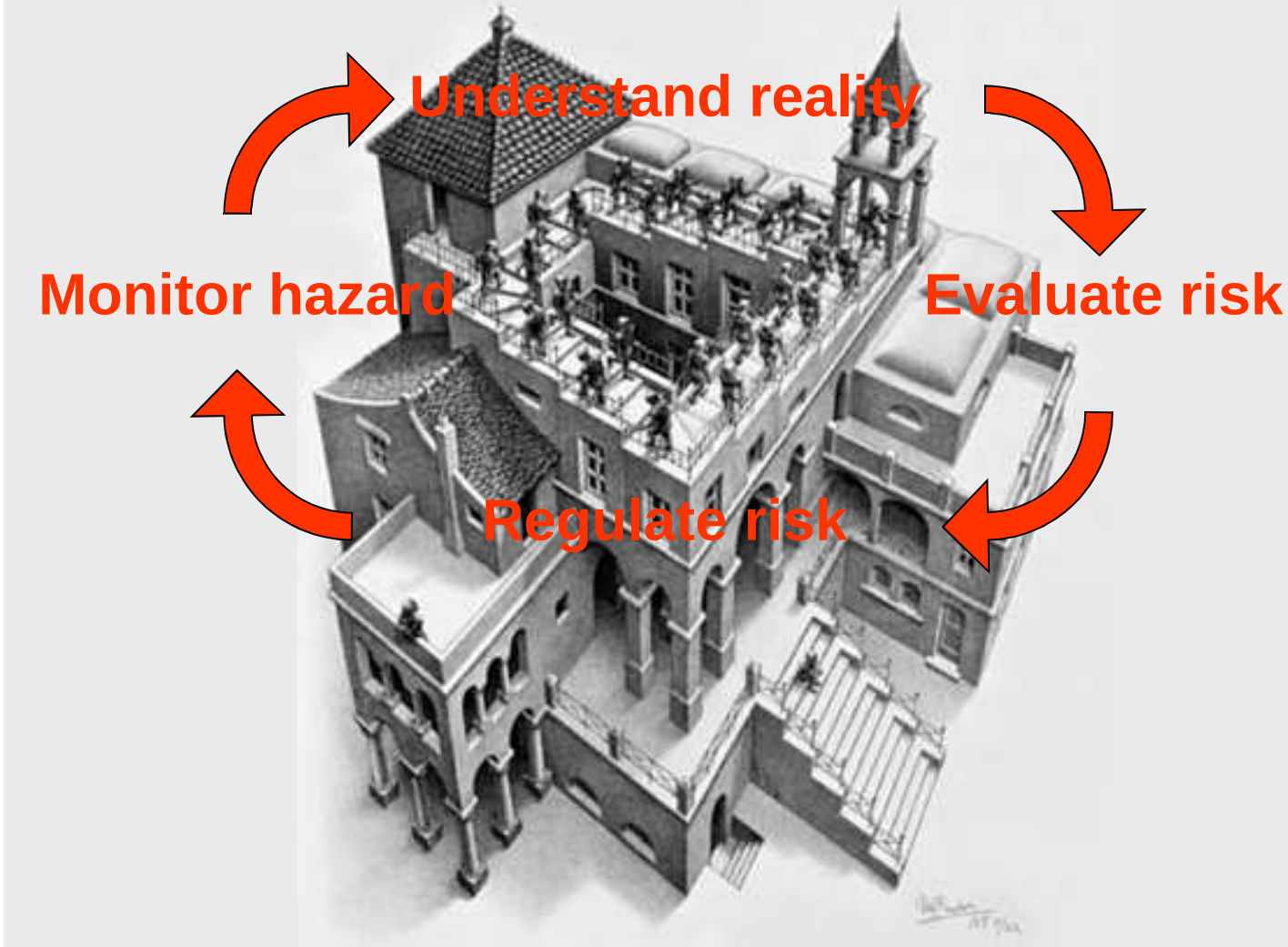
The virtuous circle of Risk assessment



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A new governance of environmental risks of chemicals

- First of all better data on chemicals and other stressors
- Transparency of pollution data at several scales (EU, National, local)
- Communication of relevant scientific information
- Dialogue with stakeholders to explain policies
- RA exercises driven by mixed panels including stakeholders
- Relevant use of prediction, observation and reactivity

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What is a decision?

Where scientists are :

Bad situation!

Good situation!

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It was my conclusion

Thank you for listening,

have a fruitful meeting.

Remember that policy makers need you, scientists, to improve their action