

# Toolkit for uncertainty and knowledge quality assessment of endocrine disruptors' risk assessment

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# Partnerships

- Dico-Risk funded by PNRE (2011-2014)
- Directed by Laura Maxim, ISCC, CNRS
- Scientific partners
  - Sandrine Blanchemanche, Inra
  - Natalia Grabar, STL, CNRS, Lille 1 & 3
  - Jeroen Van der Sluijs, Utrecht University
  - Akos Ronas-Tas, University of California, San Diego



Utrecht University



Rule

# Objective

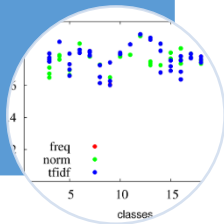
- To develop a toolbox for uncertainty analysis and knowledge quality assessment
- In order to understand the interdependencies between scientific and political dimensions of controversies surrounding endocrine disruptors
- We used the Bisphenol A as case-study but the developed tools are generic

# Three tools are developed

The three tools are built on the association of different methods and have specific purposes:

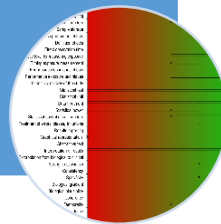
- Identify uncertainty expressed in scientific texts
- A posteriori
- Identification of uncertainty **explicitly** expressed

LUA



- Evaluate the scientific quality of risk assessment
- Interaction with experts
- Identification of uncertainty **NON explicitly** expressed

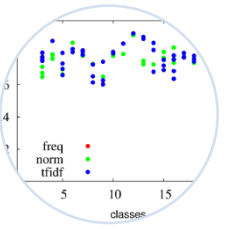
QUALICHEM



- Analyze the role of uncertainty on the political action
- A posteriori
- Identification of uncertainty **explicitly** expressed

HOLYRISK

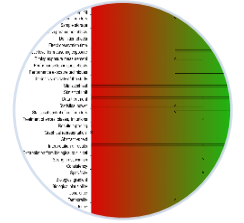




# LUA – Linguistic Uncertainty Analysis

- Objective : to provide automated instruments capable of identifying Linguistic Uncertainty expressed in the risk assessment texts
- Methods : based on methods in Natural Language Processing (NLP) to associate sentences with a class of uncertainty
- Three approaches were tested:
  - Rule-based approach
  - Approach exploiting an information retrieval system
  - Supervised machine learning approach
- Most effective: supervised machine learning
  - Can handle the largest number of classes and sentences
  - Get the automated results the nearest to the manual coding results
  - Can identify complex meanings and help human coders
- Tests conducted with two different datasets show that the methods and tools are portable from one domain to others with reliable results

# QUALICHEM (1/2)



- Objective: to assess the scientific quality of different steps in the chemical risk assessment and thus improve the transparency of expertise (esp. under REACH regulation)
- Methods: expert elicitation and development of typologies of uncertainty classes
- Validation: with 28 scientists (BPA specialists)
- Production of a family of 3 tools based on the same principles

## Qualichem\_in-vivo

- To assess the quality of in vivo studies

## Qualichem\_epidemiolo

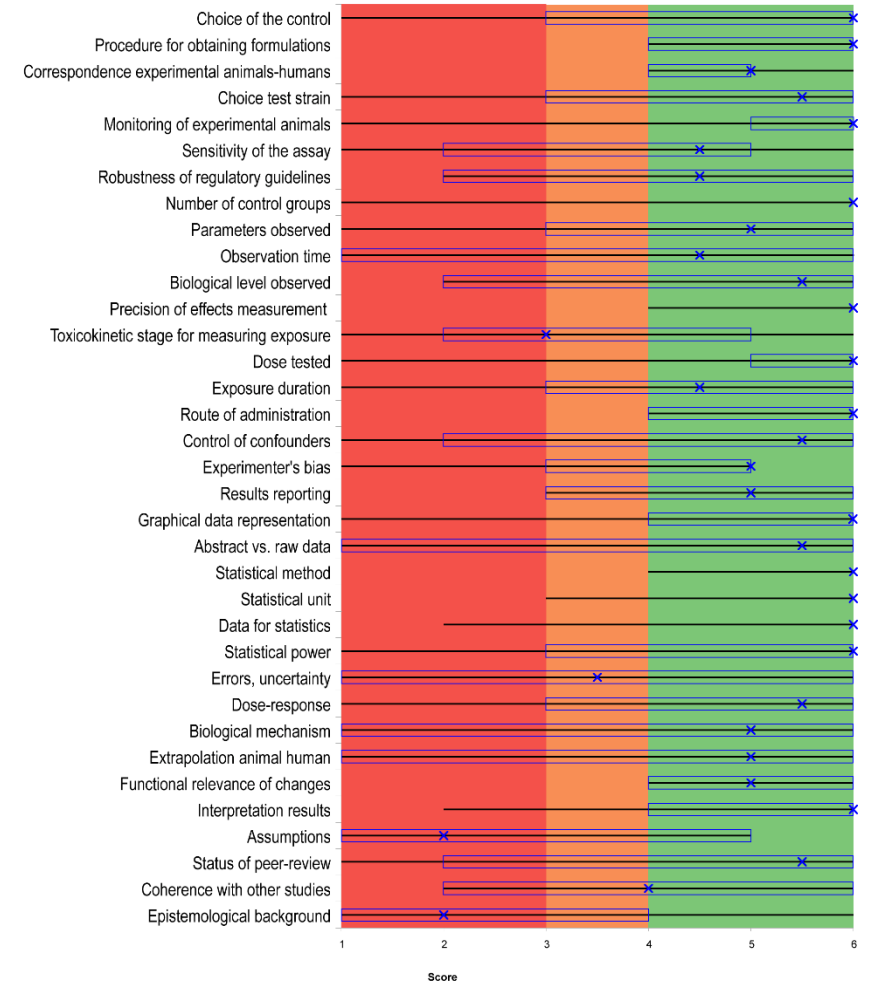
- To assess the quality of epidemiological studies

## Qualichem\_review

- To assessment literature reviews (hazard identification & characterization)

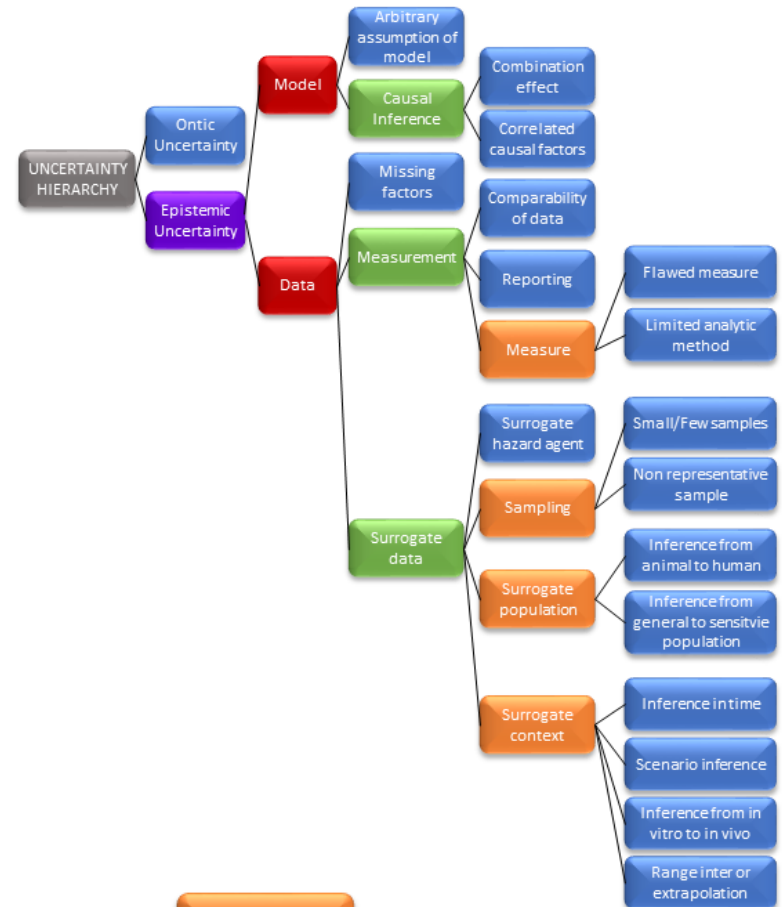
# QUALICHEM (2/2)

- List of quality criterion
- Scale 1- Strongly disagree 6- Strongly agree
  - Identification of controversial criteria Score < 3 or  $\neq 2$  points between 2 score
  - High quality (**median > 4**)
  - Low quality (**median < 3**)
- Allow expression of expert judgments in a structured way
- Considerable inter-individual heterogeneity among scientists assessing the quality of the same study, using the same criteria
- Qualichem assesses the overall level of uncertainty in a study, expressed as a confidence level.



# Holyrisk (1/3)

- Objective : understand the nature of scientific uncertainty in risk assessment and its consequences for policy decision making
- Methods: coding of risk assessment (177) and risk management (174) document and development of an original ontology of uncertainty and judgment variables
- Comparison: Contaminants/Biohazard; Europe/USA
- Validation: Supervised machine learning





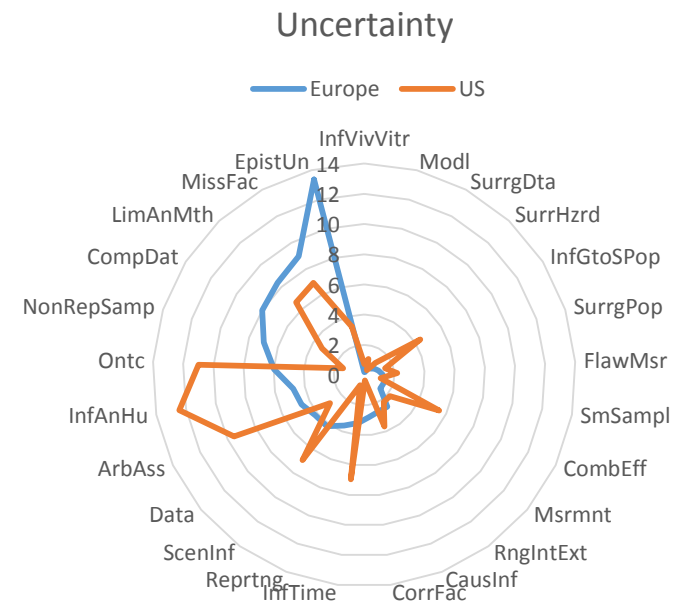
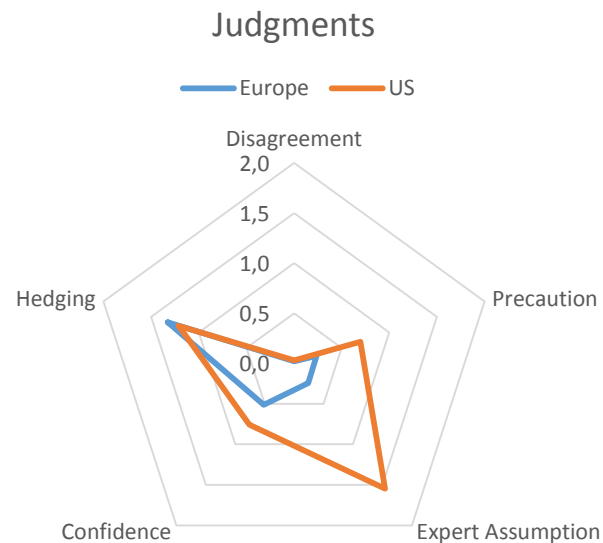
# Holyrisk (2/3)



- « National style » (US vs Europe)

The US Risk Assessments express:

- More uncertainty (8,1 variables/doc vs 3,1)
- More precaution (0,7 vs 0,2) and more expert assumption (1,5 vs 0,2)
- More specific uncertainty and less epistemic uncertainty



# Holyrisk (3/3)



- Cumulative knowledge increases the expression of uncertainty in RA

- The more referenced cited
- The older the earliest RA
- The longer time to deliver the report

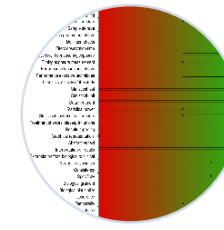
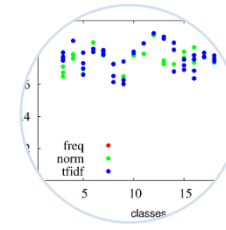


The more uncertainty is expressed but it is more specific

- What about the consequence of uncertainty/precaution on risk management decision?

- 2/3 of RA result in No Action
- If the expert panels recommend action, it has little effect on risk management measures
- The most general Uncertainty – epistemic – inhibits action while the others have a positive relationships
- More expressions of precaution the more likely it is that there will be strong action

# Conclusion



- Strategic use of sciences in interpreting uncertainties
- Considerable difference among experts in assessing quality criteria
- National style and epistemic cultures in expressing uncertainties
- Science & Expertise should not be taken for granted