Uncertainty Analysis in Geography Referenced Probabilistic Environmental Risk Assessment

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Objectives

The **objective** is to improve the probabilistic environmental risk assessment allowing to more accurately estimate and refine the **risk** of adverse effects occurring to organisms or ecological systems due to possible exposure(s) to chemicals. An important element in this methodology is that a confidence interval will be calculated for this risk.

Case study: - River basins in Flanders (Belgium).
- spatial risk patterns of the **pesticide atrazine** were predicted

Probabilistic Environmental Risk assessment (PERA) is based on comparing
- an **E**nvironmental **C**oncentration **D**istribution (**ECD**) = **Exposure Analysis**
- a **S**pecies **S**ensitivity **D**istribution (**SSD**) = **Effects Analysis**

PERA accounts for the variability and uncertainty, inherent to the environment.

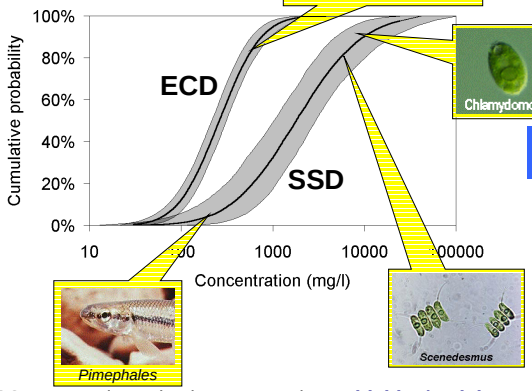
Variability: - represents inherent heterogeneity or diversity
- is not reducible through further measurements

However, variability can be refined by geo-referencing the risk assessment.

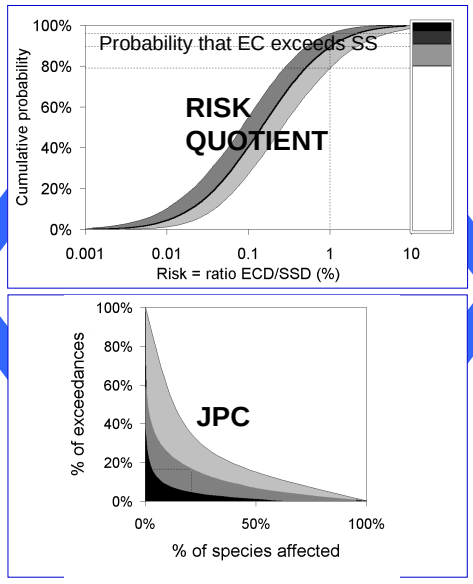
Uncertainty: - represents ignorance, measurement and/or sampling error
- can partly be reduced through further research
- Here, **bootstapping** is used for predicting sampling error

Methodology

ECD: e.g. **temporal variation** of a chemical concentration for a monitoring station

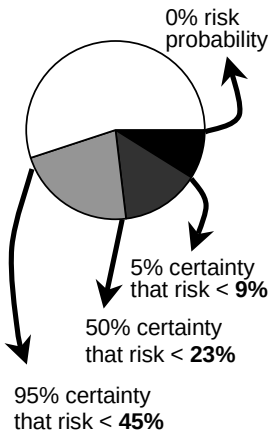


SSD: several species have several **sensitivities/toxicity** towards a chemical



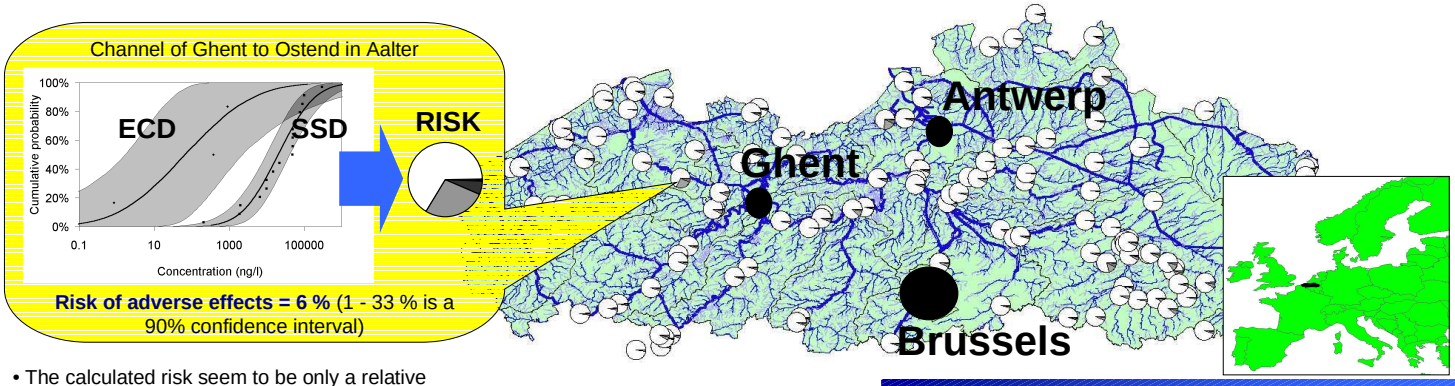
Risk can be predicted based on
1. Risk quotient = ratio ECD/SSD
2. Joint Probability Curve (JPC)

Both result in the same risk pie chart



In PERA, the contribution of spatial variability to the ECD can be quite high. By geography referencing the risk assessment, the spatial variability is explicitly accounted for in each local risk assessment.

Results & Discussion



- The calculated risk seem to be only a relative measure; despite the large overlap of ECD & SSD, the predicted expected risk is 6%

- Geography referencing the risk is only useful when both the ECD and the SSD are geography referenced. In the case study, only the ECD was geo-referenced. The SSD was the same for every location while in reality spatial differences lead to different local SSD's . Hot spots could also be found based on the geo-referenced ECD's.

TAKE HOME MESSAGE

- Probabilistic environmental risk assessment (PERA) results in a more realistic risk assessment and therefore improves decision support of individual chemicals. The uncertainty interval is important for the decision-maker since it expresses how reliable the risk assessment is.

- Some suggestions for further improvement: (1) the tails should be considered more in the risk calculation and (2) the effects assessment should also be geography referenced in order to refine the entire risk assessment.

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