UNIVERSITEIT GENT

BIOMATH
Department of Applied Mathematics, Biometrics and Process Control

Uncertainty and variability in spatio-temporal probabilistic risk modelling

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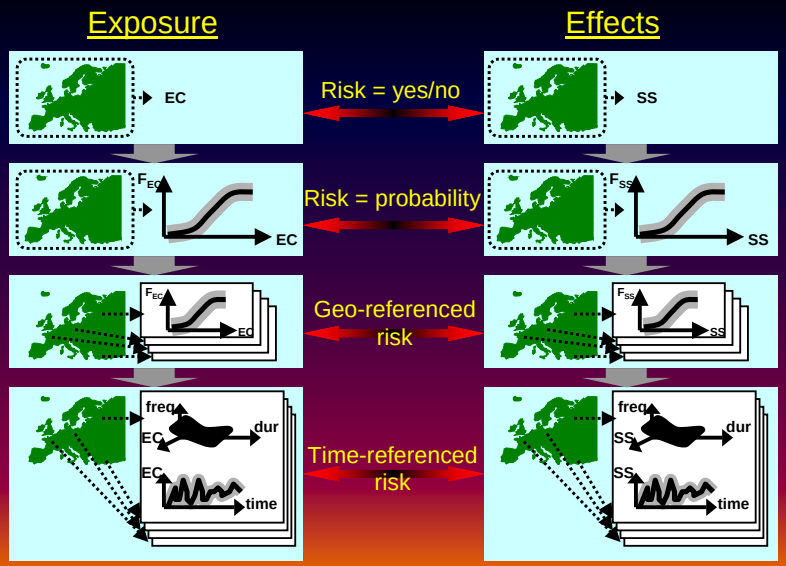
Outline

- Introduction
- Screening risk assessment
- Probabilistic risk assessment
- Geo-referenced probabilistic risk assessment
- Time-referenced probabilistic risk assessment
- Conclusions

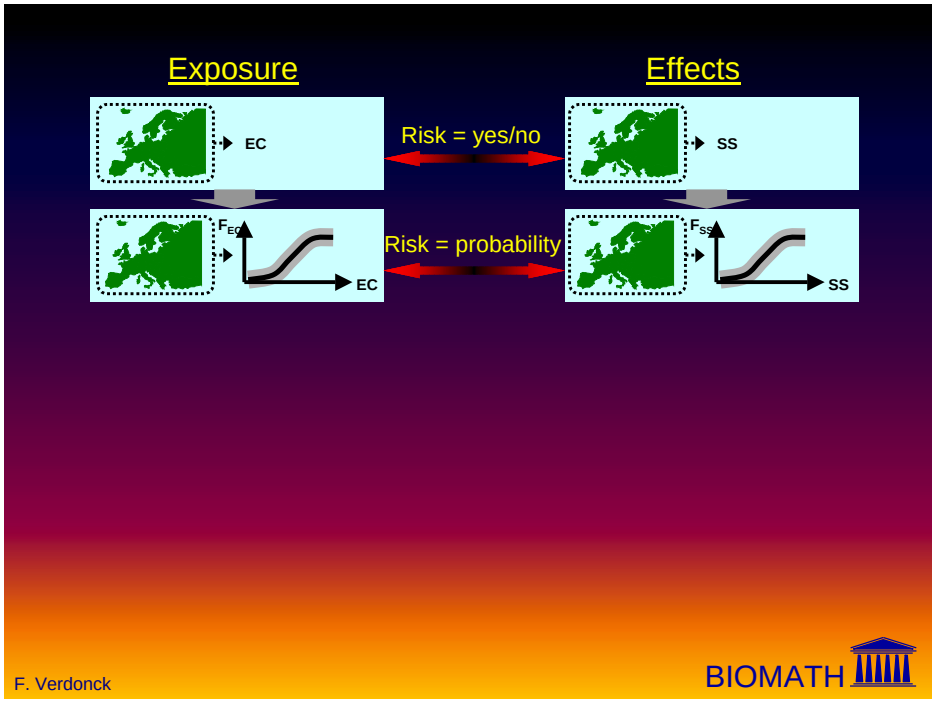


Ecological risk assessment

Introduction

- Current risk analysis approaches are:
  - not so realistic & transparent
  - don't stimulate further research
  - don't distinguish between uncertainty and variability

>> Use of probabilistic approaches



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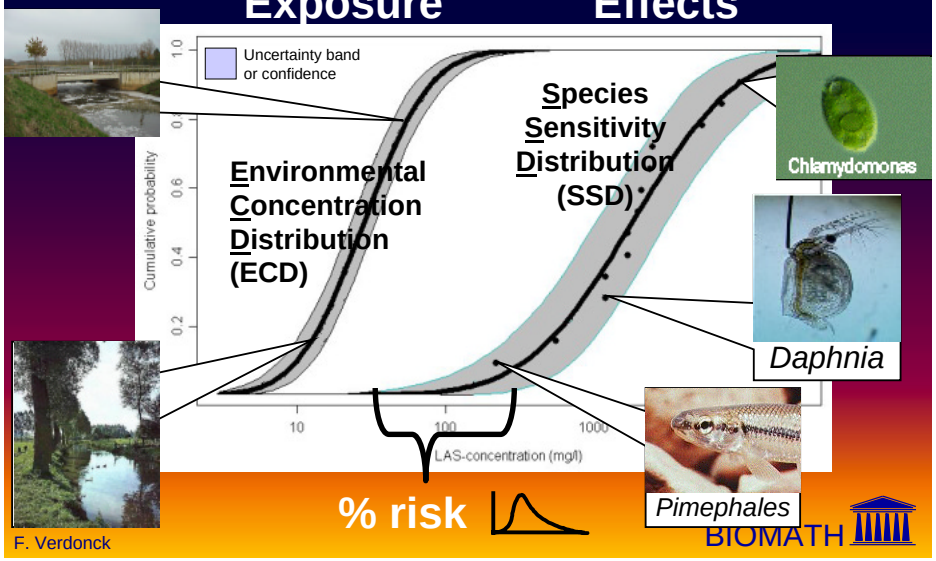
Probabilistic risk assessment



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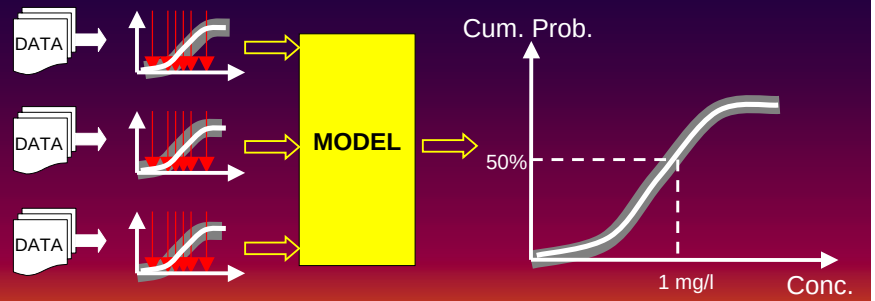
Probabilistic Modelling

Propagation of distributions in Monte Carlo analysis

- Uncertainty **OR** variability: **one**-dimensional Monte Carlo
- Uncertainty **AND** variability: **two**-dimensional Monte Carlo



50% of the time
<> 50% certain

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Potential issue

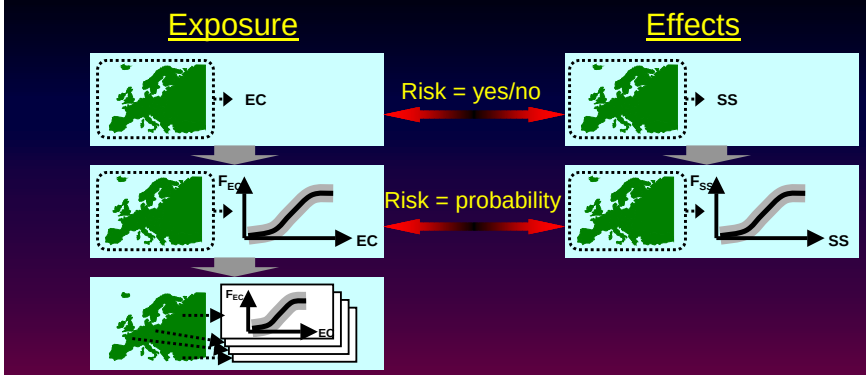
- Current risk analysis approaches are:
  - not so realistic & transparant
  - don't stimulate further research
  - don't distinguish between uncertainty and variability

>> Use of probabilistic approaches

  - A lot of spatial and temporal variability (large variance for EC and SS, e.g. on a European level)

  > RISK = P(EC > SS)

>> Development of spatio-temporal framework



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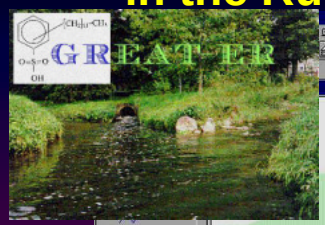
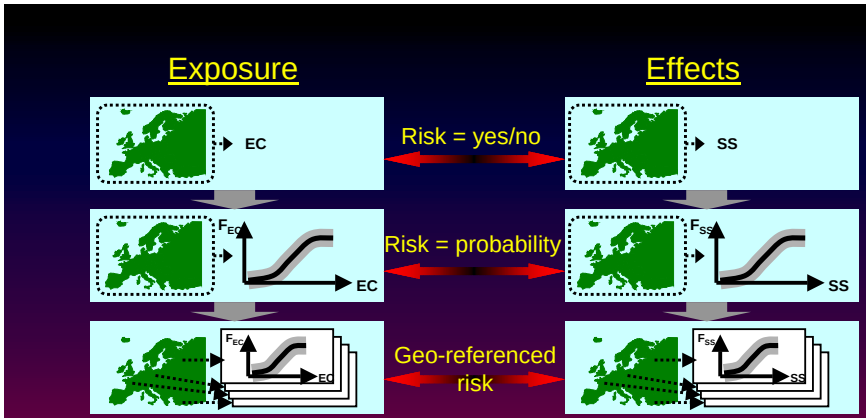
Case study on a detergent in the Rupel basin (Belgium)





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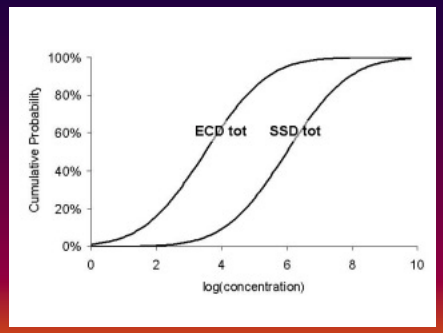
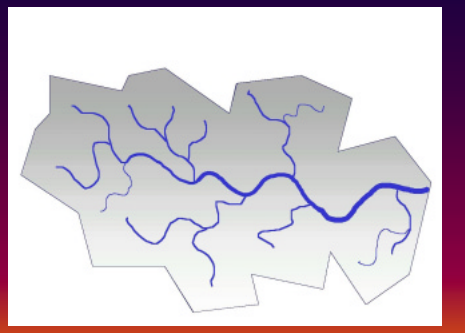
Geo-Risk most useful when both ECD and SSD are geo-referenced

Risk = P(EC > SS)





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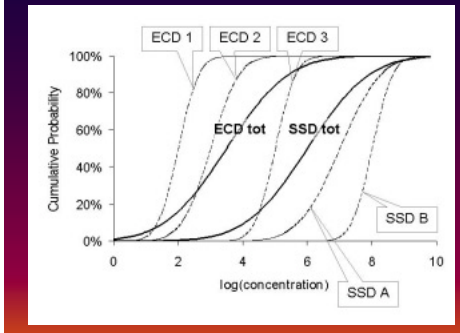

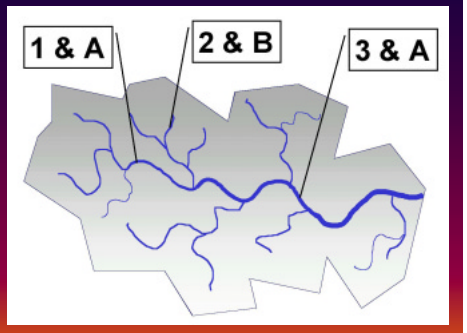

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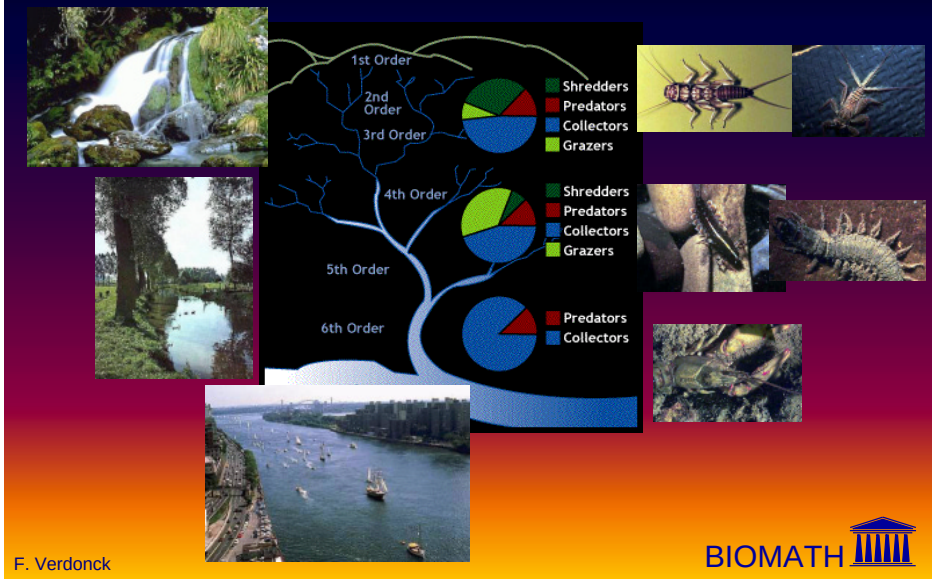
Geo-SSD: Species presence



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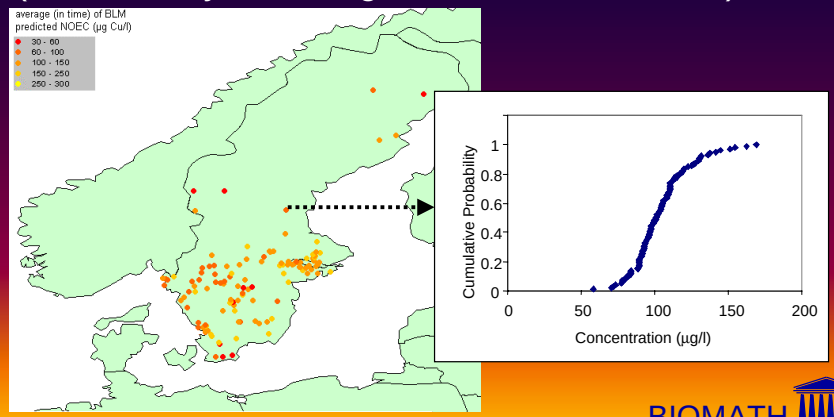
Geo-SSD: Bioavailability

Water characteristics (DOC, pH,…) determine the bioavailability of Cu towards *Daphnia magna* (modelled by Biotic Ligand Model in Sweden)



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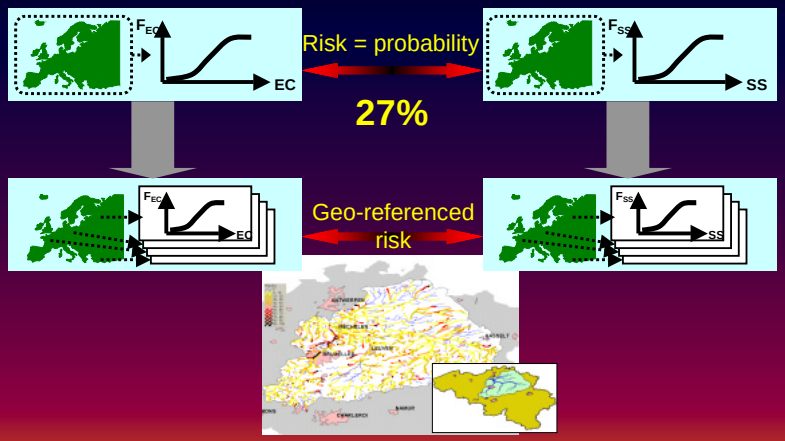
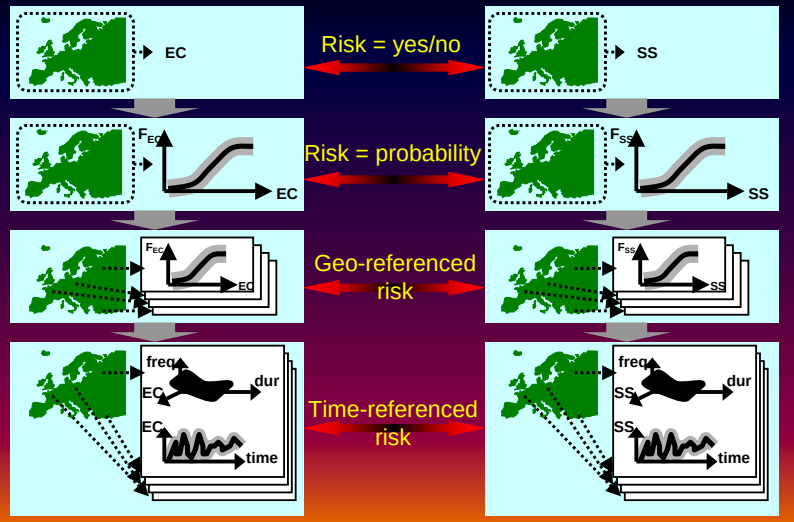
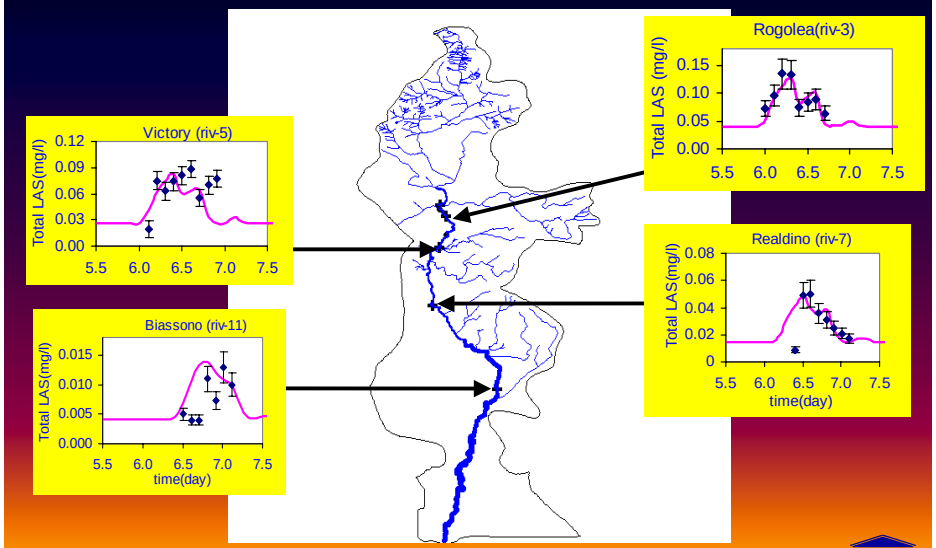
Case study on detergent in Rupel (B)



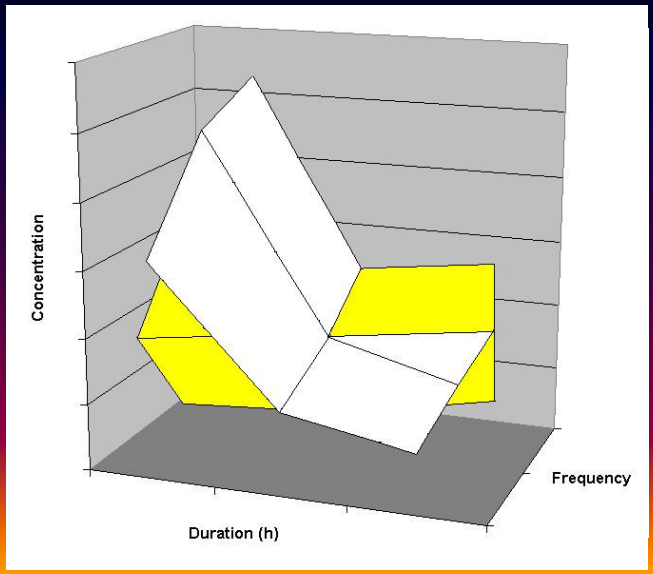
Risk is not reduced, it is more realistic (refined)!



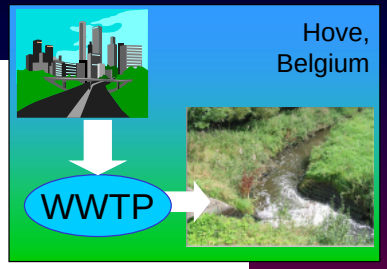
Case study on LAS in the Lambro basin (Italy)



Concentration-Duration-Frequency



Time-referenced PERA: Case for NH_3



Conclusions

- Probabilistic risk assessment accounts for uncertainty & variability of both exposure concentration and species sensitivity (and finally risk)
- Uncertainty and variability should be separated in order to correctly interpret distributions
- Explicitly accounting for variability makes the risk assessment more realistic and refined:
  - Geo-referencing refines spatial variability
  - Dynamic simulation refines temporal variability