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Effect of Uncertain Statistics of Pesticide Fate Parameters on Predicted Worst-Case Environmental Concentrations.

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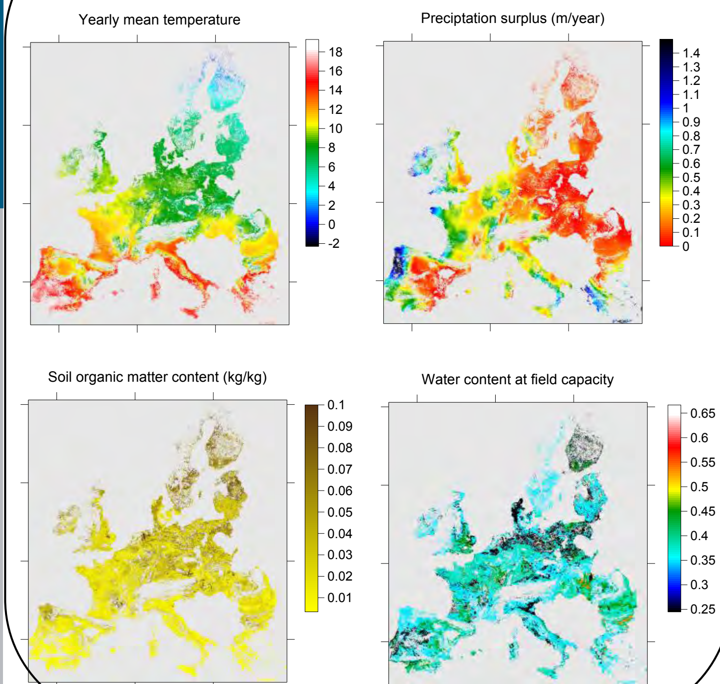
Introduction

Soil Climate properties



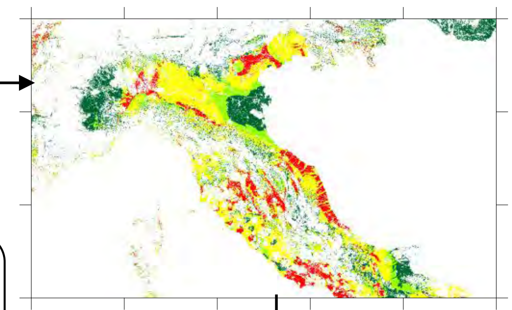
Pesticide parameters:

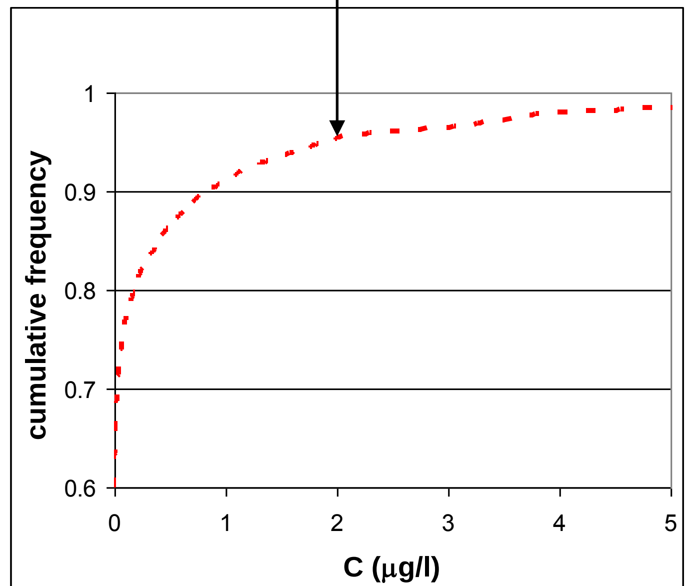
Kom and DegT50

Pesticide Fate model

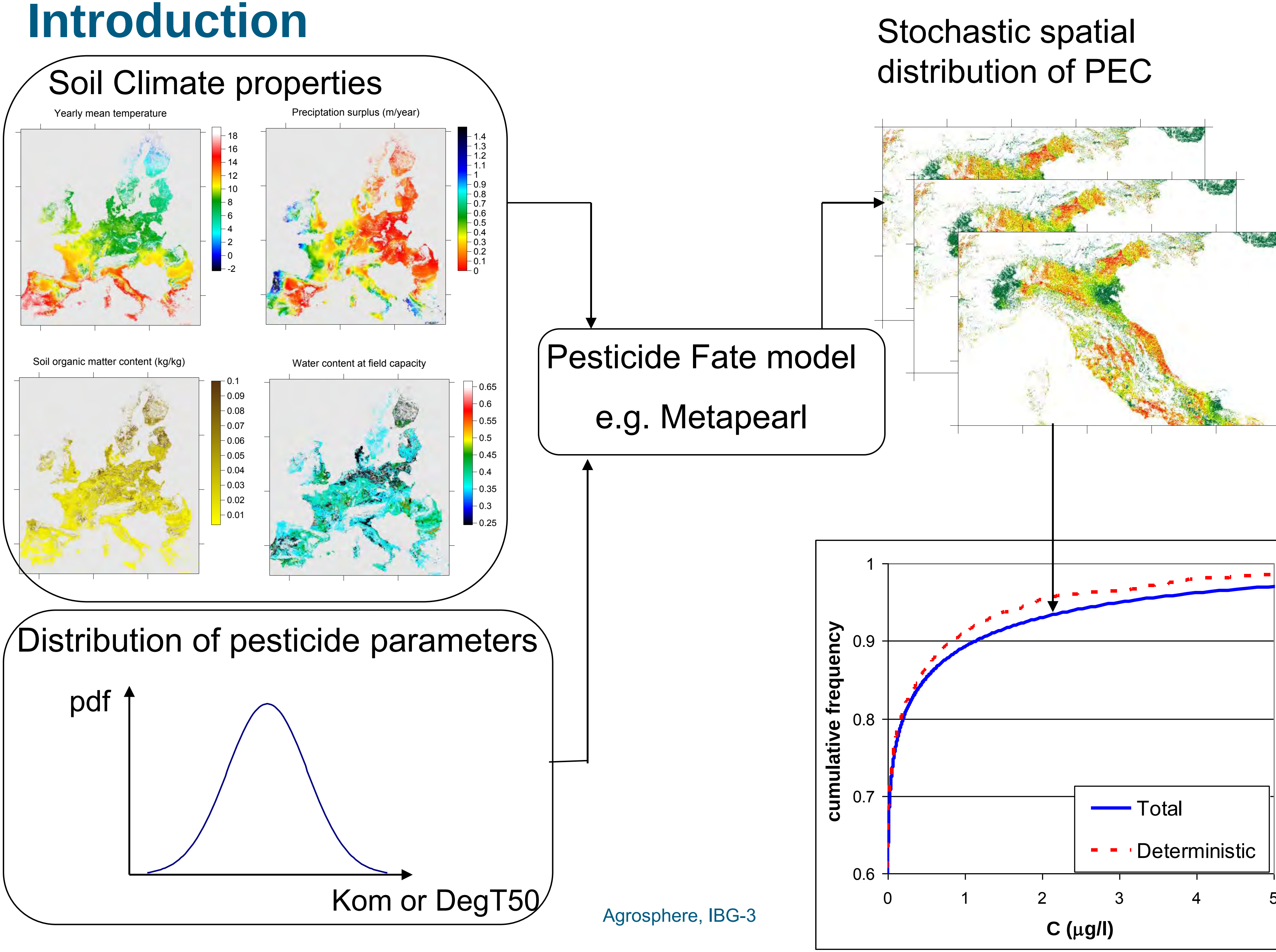
e.g. Metapearl

Deterministic spatial distribution of PEC





Introduction



Introduction

Uncertainty in pesticide fate parameters leads to:

- uncertainty in prediction of local pesticide concentration,
- a stochastic spatial distribution of pesticide concentrations
- … with higher concentrations for higher percentiles.
- For leaching concentrations to groundwater, the effect of uncertain pesticide fate parameters on the distribution of pesticide concentrations is not very large.

See Jan Vanderborght, Aaldrik Tiktak,Jos JTI Boesten and Harry Vereecken, Effect of pesticide fate parameters and their uncertainty on the selection of ‘worst-case’ scenarios of pesticide leaching to groundwater, *Pest Manag Sci 2011; 67: 294–306*

General Assumption and its Consequences:

Assumption

- Statistics of pesticide fate parameter distributions are known.
- Population of pesticide fate parameters is known.

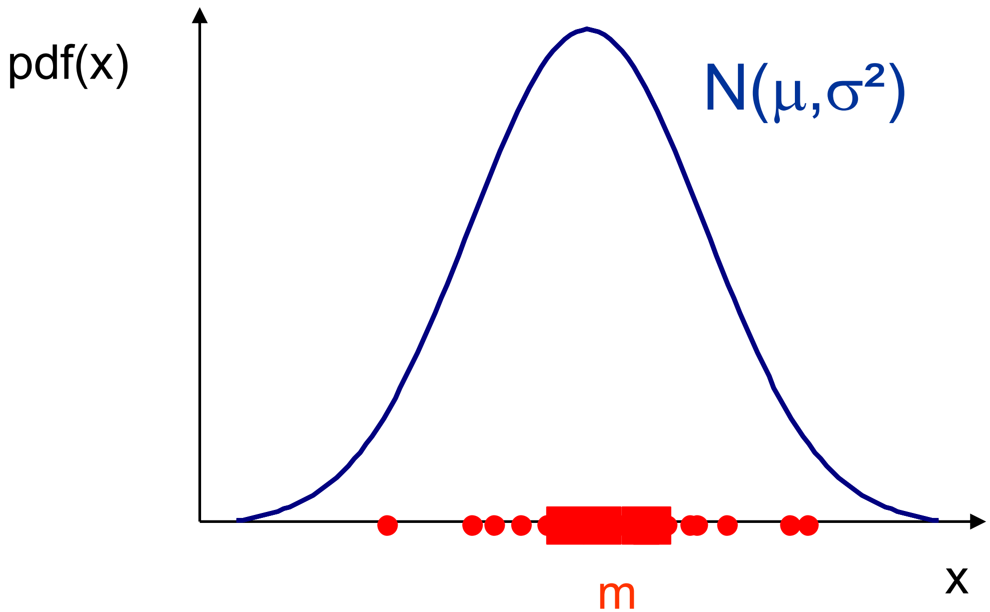
Consequences

- Percentiles of the stochastic pesticide distribution can be derived exactly.
    - No uncertainty about the percentiles of the distribution (even though the local pesticide parameters are uncertain)
    - No uncertainty in the risk assessment

- But, to determine the pesticide fate parameter population, an inifinite number of samples is required.

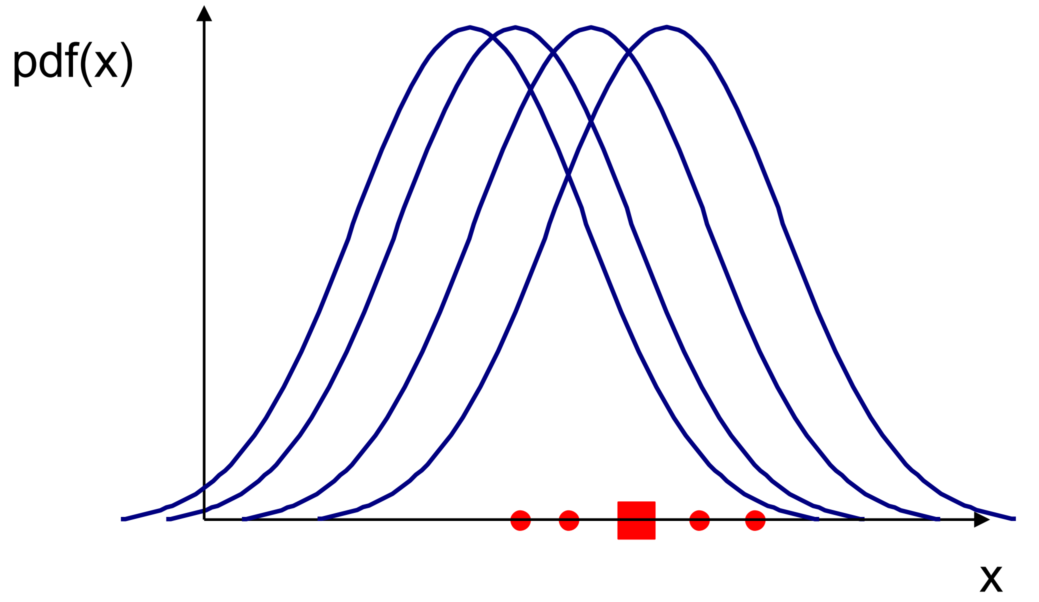
Sample versus Population

In reality, only a limited number of samples is available.



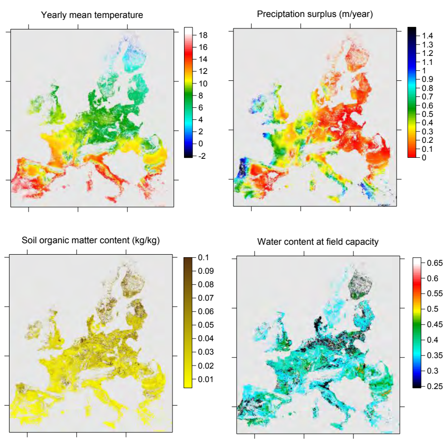
The mean (m) and variance (s²) of the pesticide fate parameters that are derived from the sample are uncertain and may differ from the ‚true' population statistics: population mean μ and variance σ^2 .

Sample versus Population



- The statistics of the ‚true' population (population mean μ and population standard deviation σ) may differ from the sample statistics (sample mean m and sample standard deviation s)
- The inference of the true population statistics from a finite sample is uncertain.

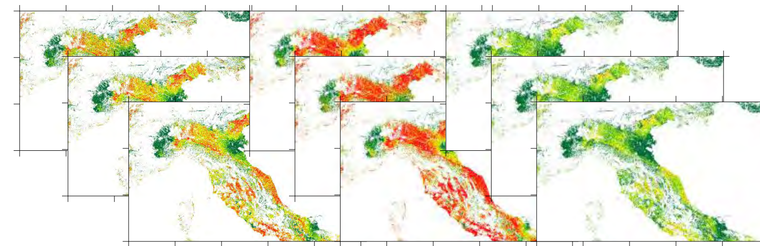
Soil Climate properties

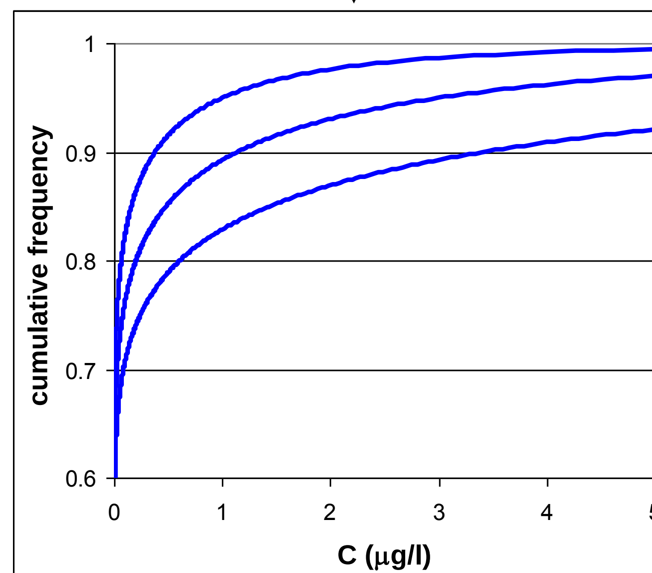


Pesticide Fate model

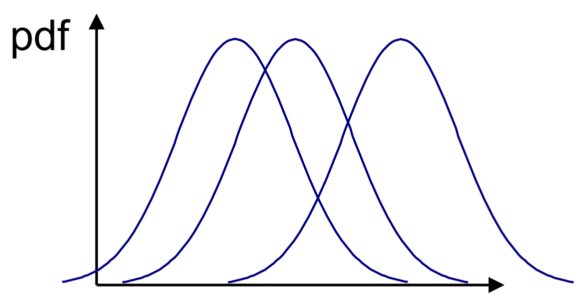
e.g. Metapearl

Sets of stochastic spatial distributions of PEC





Uncertain distribution of pesticide parameters



Uncertain statistics of pesticide parameters

- Due to a limited number of samples, the sample statistics (e.g. sample mean) are uncertain.
- Uncertainty about the statistics of the pesticide parameter distribution (e.g. uncertainty about the mean parameter due to a limited number of samples) leads to uncertainty about the distribution of the predicted pesticide concentrations (e.g. uncertainty about a certain percentile of the distribution).
- This uncertainty leads to an uncertainty in risk assessment that is based on percentiles of predicted concentrations.

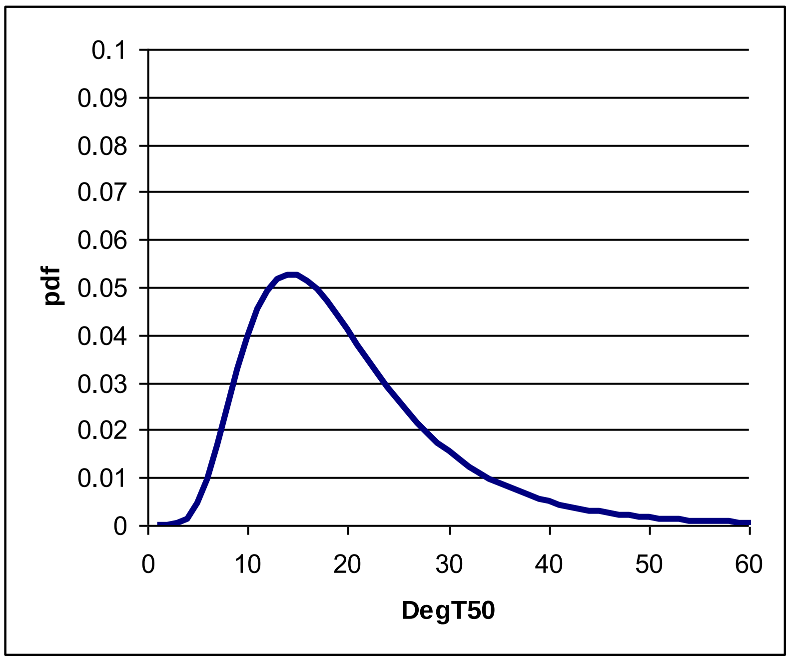
Example

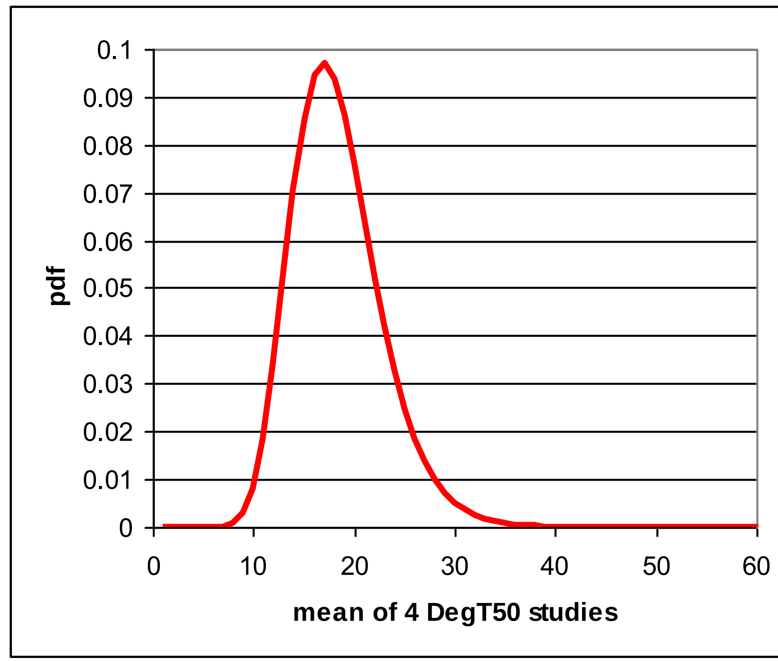
Substance D:

DegT50 = 20 d   Kom = 35 l/kg

CVDegT50=CVKom=0.5

4 degradation and 4 sorption studies



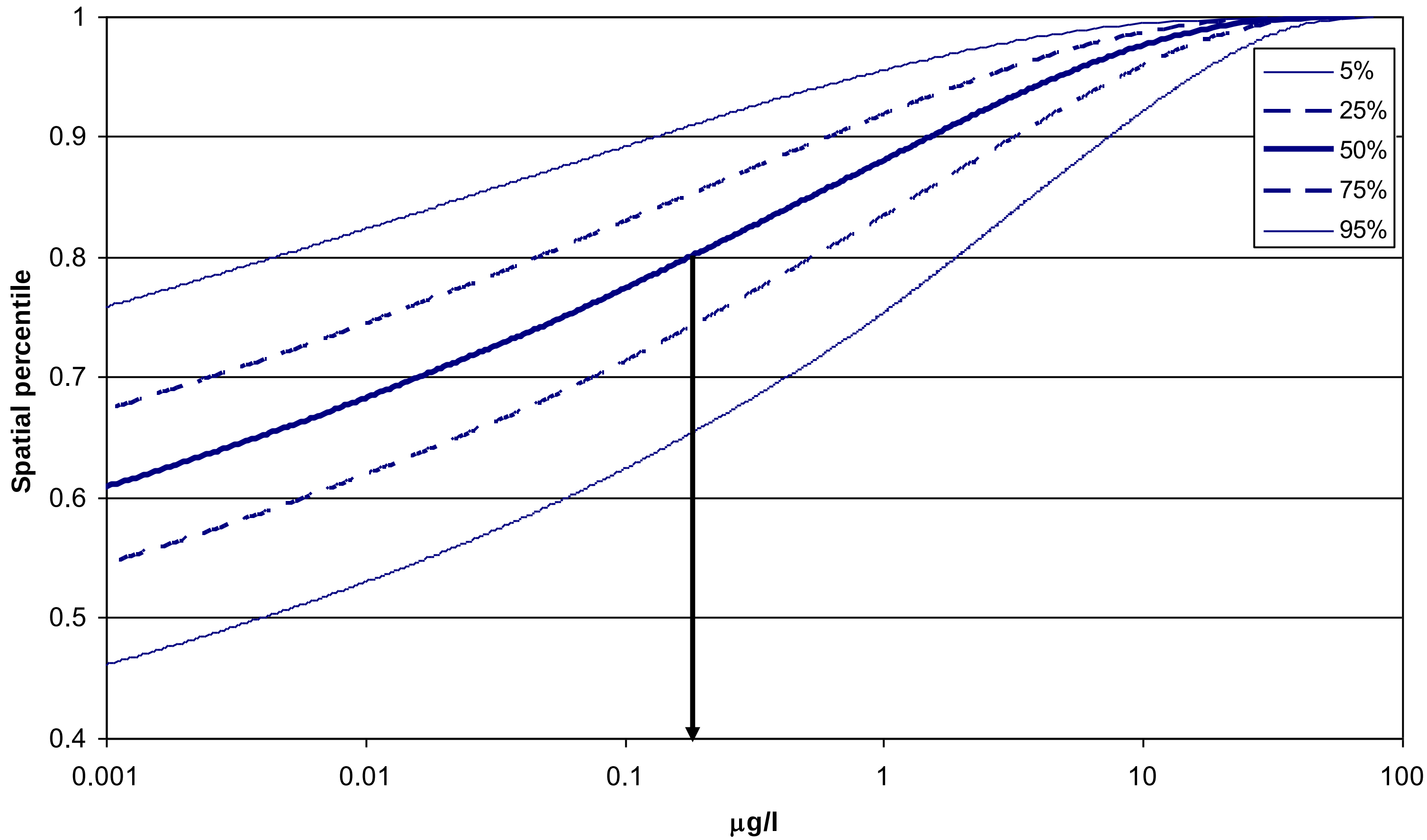


Example

- Predictions of 80% temporal percentile of leaching concentrations to groundwater using Metapearl (Tiktak et al., 2006, JEQ, 35:1213-1226)

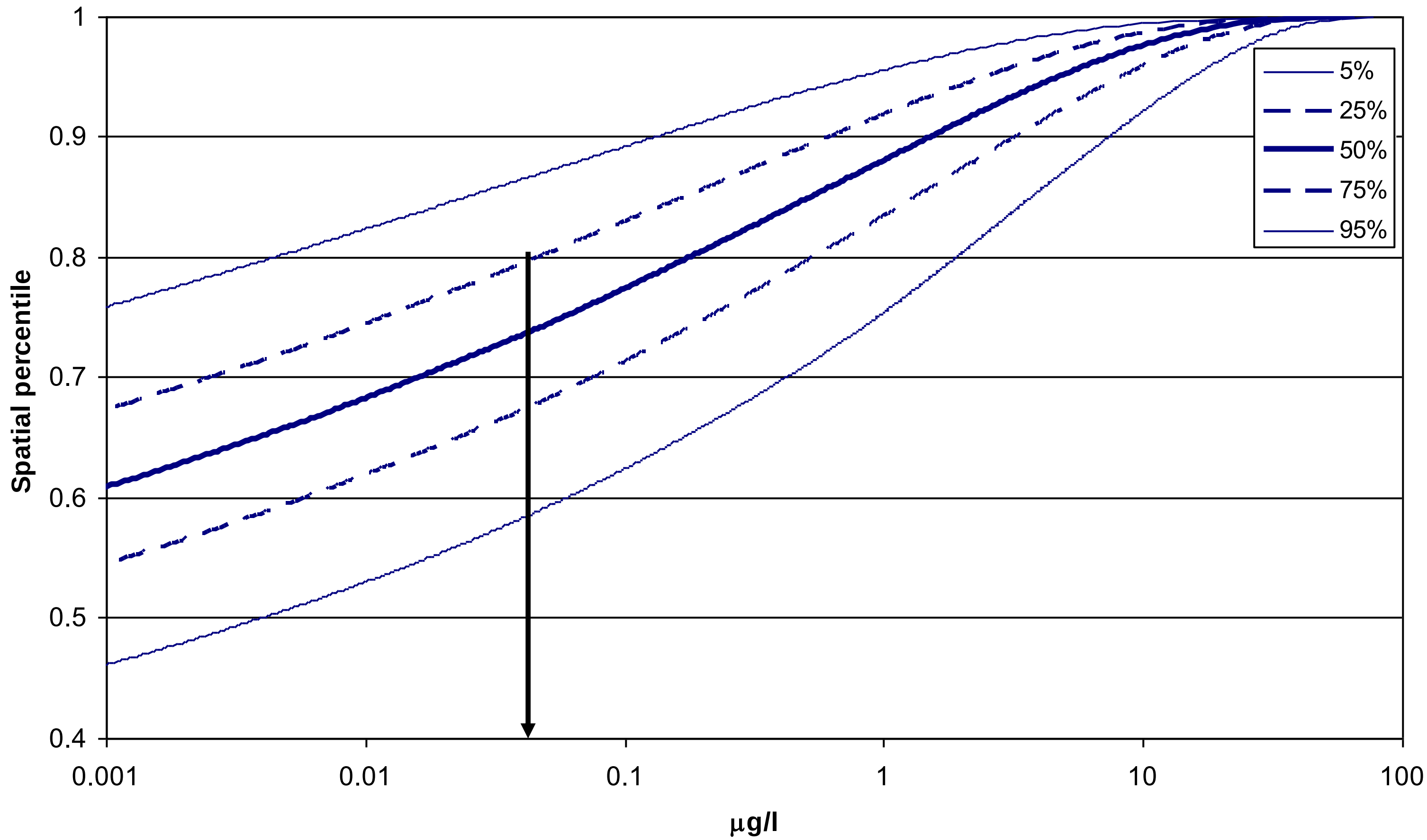
- in the agriculturally used area in the EU27.

Example: Uncertainty of Spatial Distributions



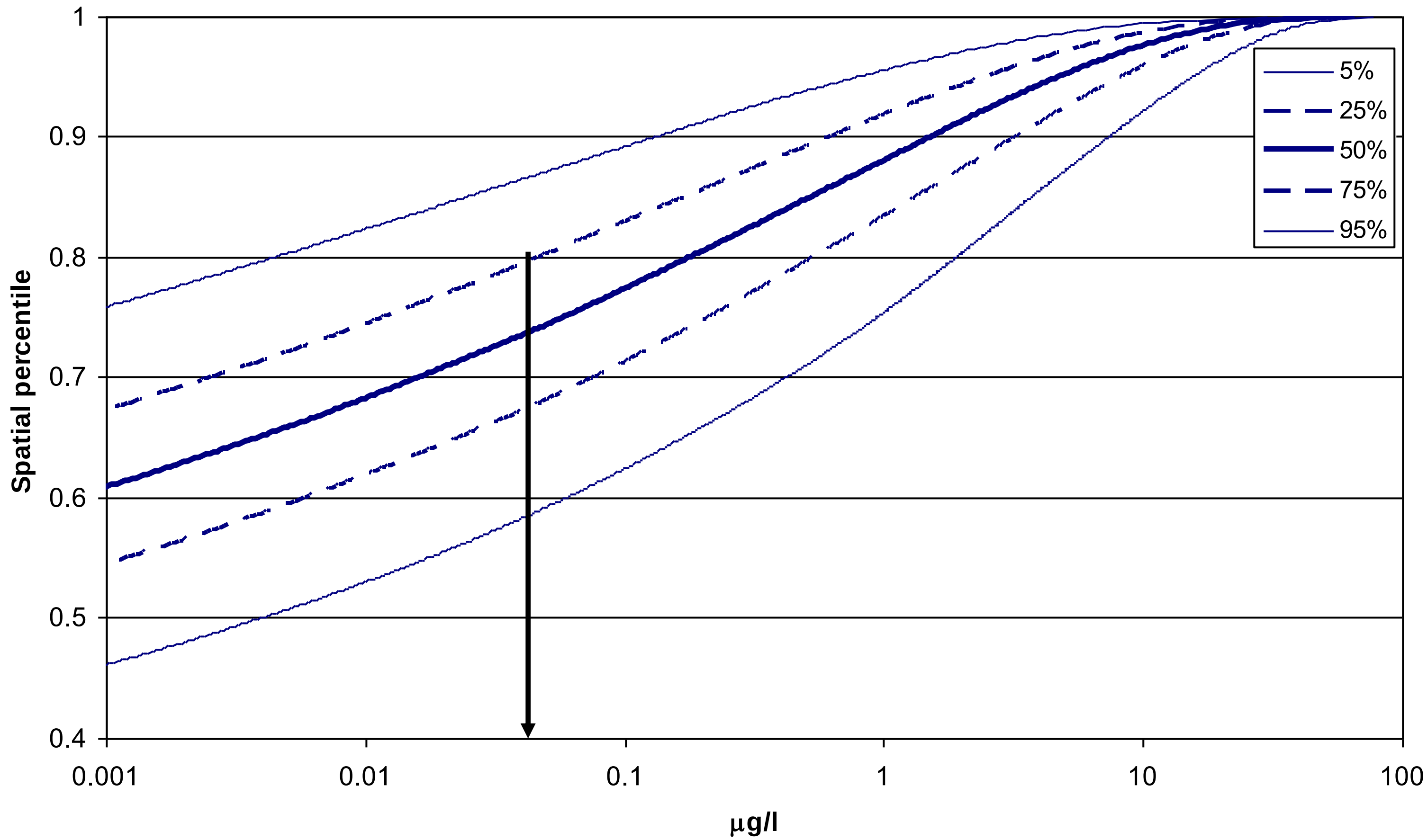
For the true distrubition of pesticide fate parameter, the 80th percentile of the spatial distribution of substance D is 0.18 µg/l

Example: Uncertainty of Spatial Distributions



There is a chance of 25% that for this substance and a dossier with 4 studies, mean pesticide fate parameters are obtained for which the 80th spatial percentile of predicted leaching concentration is lower than 0.046 μg/l

Example: Uncertainty of Spatial Distributions



There is a chance of 25% that for a dossier with 4 studies with mean parameters that are equal to those of substance D, the true mean parameters lead to an 80th spatial percentile of predicted leaching concentration lower than 0.046 µg/l

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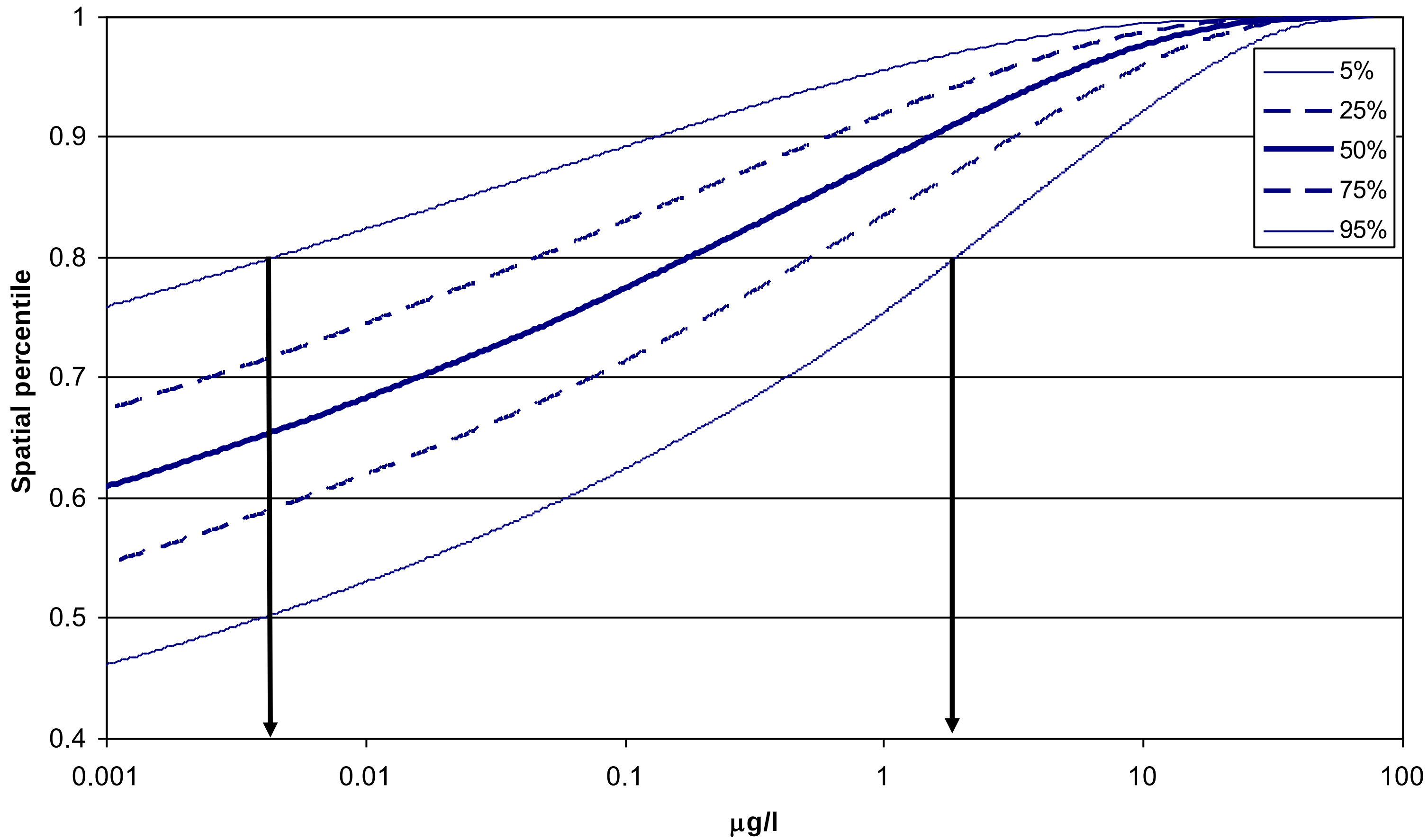
Example: Uncertainty of Spatial Distributions



For a dossier with 4 studies with mean parameters that are equal to those of substance D, the 90% confidence interval of the derived P80 concentration is [0.0043 μg l^{-1}, 1.86 μg l^{-1}].

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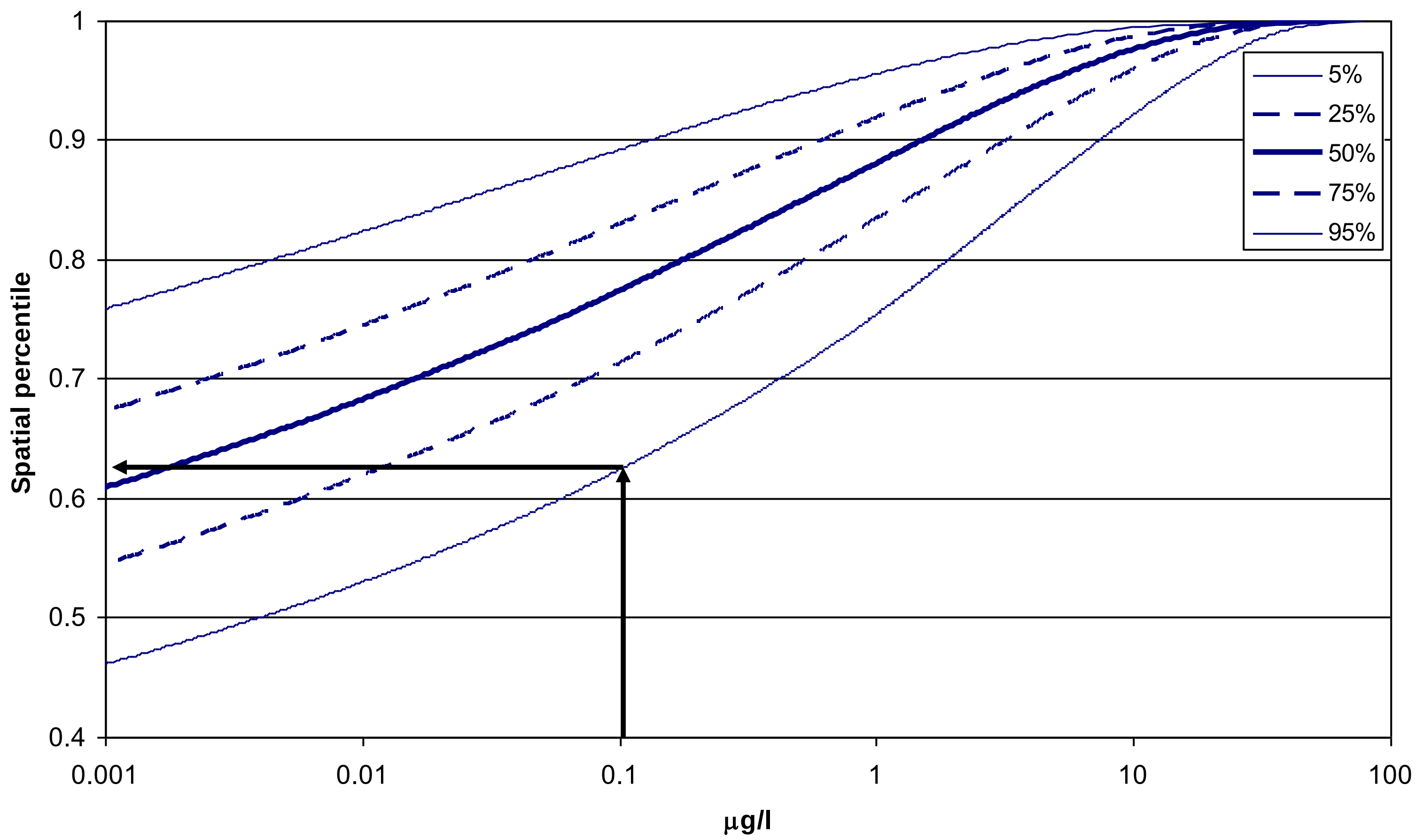
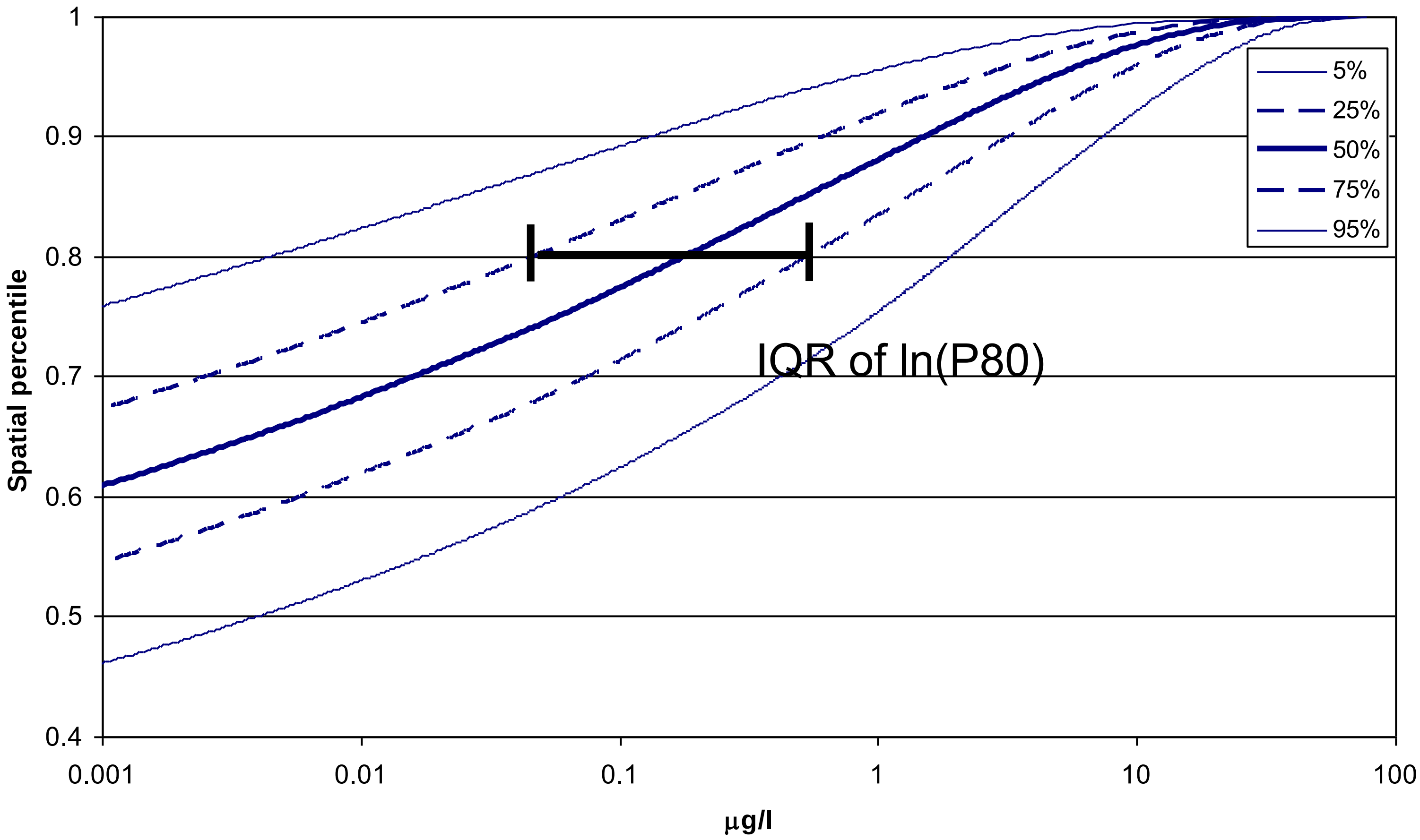
Example: Uncertainty of Spatial Distributions

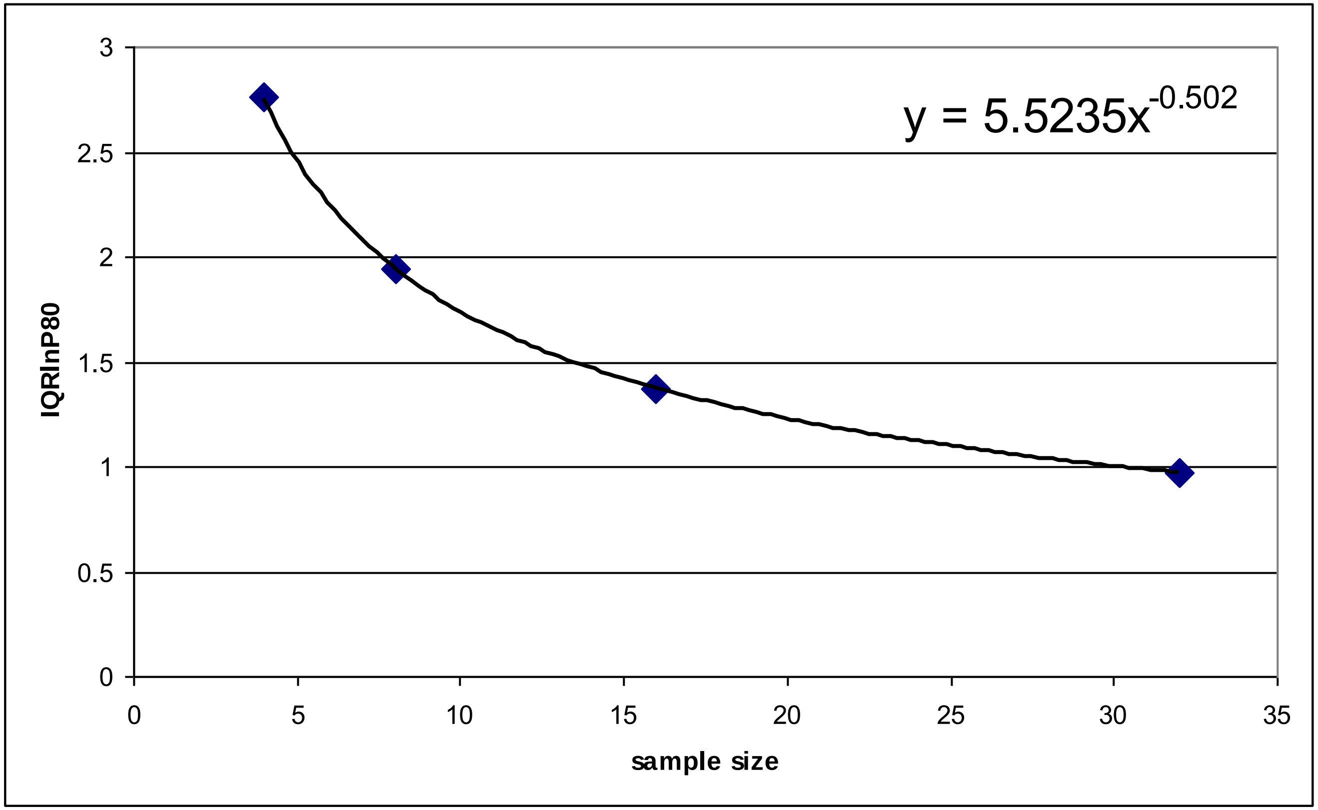


For a dossier with 4 studies with mean parameters that are equal to those of substance D, there is a probability of 5% that the 0.1 µg/l treshold is exceeded in more than 38% (100-62) of the total area.

Example: Effect of Sample Size



Example: Effect of Sample Size



- Uncertainty of mean parameters ~ (sample size)$^{-0.5}$
- The used metamodel Metapearl is a linear relation between the pesticide fate parameters and lnC.
- Uncertainty of the percentiles of lnC ~ (sample size)$^{-0.5}$

Conclusions

Uncertainty about pesticide fate parameters is different from uncertainty about the statistical parameters that characterize the pesticide fate parameter distributions.

Uncertainty about pesticide fate parameters has a modest impact on the spatial distribution of leaching concentrations and ist percentiles.

Uncertainty about the statistical parameters that characterize the distribution of pesticide fate parameters leads to a large uncertainty about the percentiles of the leaching concentration distribution.

This uncertainty can be reduced by increasing the number of studies.