IMWA 2010, Sydney, Nova Scotia, Canada, September 5 to 9

Mine Water Characterization for Probabilistic Modelling and Uncertainty Analysis

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IMWA 2010 Mine Water & Innovative Thinking

CAPE BRETON UNIVERSITY

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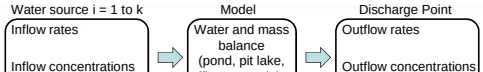
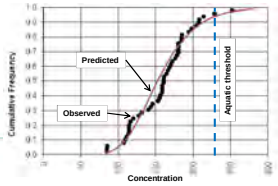
Water Quality Modelling



Issue: Limited number of water samples to characterize source loadings

Objective: Defining the realistic range of outflow concentrations



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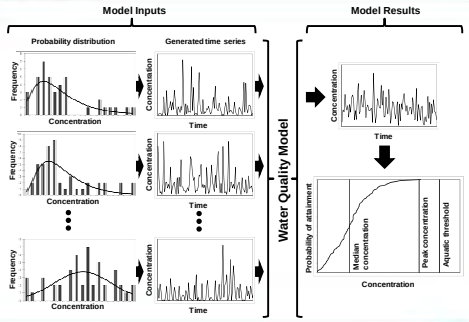
Probabilistic Water Quality Modelling Structure



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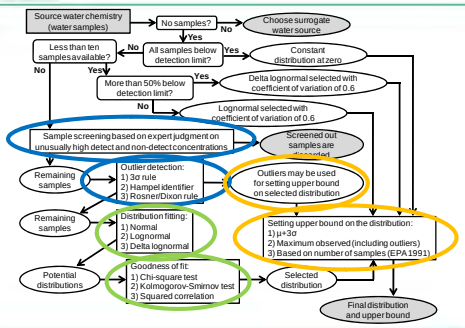
Processing of Water Sample Concentration Data



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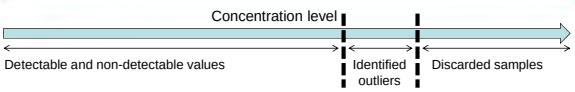
Data Description



Discarded samples: Selected based on expert judgment (unusually high detectable and non-detectable values)

Identified outliers: Identification from a pool of acknowledged detection methods (e.g. 3σ rule, Hampel identifier, Rosner/Dixon rule). A value is considered an outlier only if all methods provide a positive diagnostic, or from expert judgment.

Iterative process: Loop, starting with no discarded sample, with step by step refinement (judgment calls on outliers and discarded samples).

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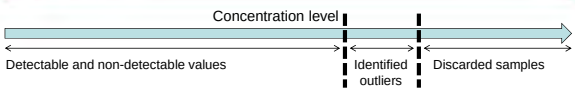
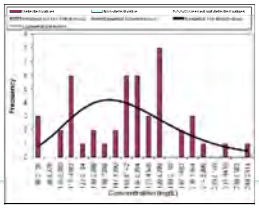
Distribution Fitting



Data used for fitting a probability distribution



Typical distributions (EPA 1991):
-Normal
-Lognormal
-Delta lognormal

Goodness of fit (pool of methods):
-Chi-square test
-Kolmogorov-Smirnov test
-Square correlation
-Visual inspection

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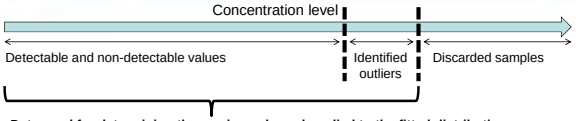
Selection of a Maximum Bound

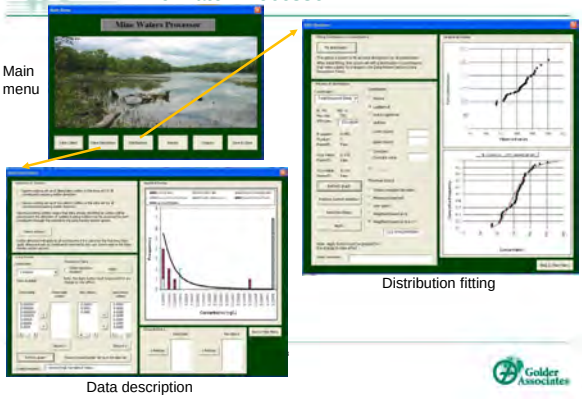


Data used for determining the maximum bound applied to the fitted distribution.

Determined from a pool of methods:
-μ+3σ
-Maximum observed, including outliers
-Based on the number of sample (EPA 1991)

Mine Water Processor

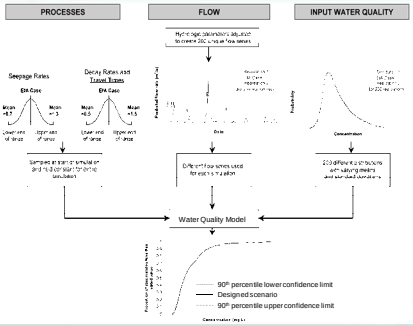
Main menu



Distribution fitting

Data description

Water Quality Uncertainty Analysis Model



Defining Uncertainty on Concentrations

Standard deviation:

Realizations of $s_{obs} : s_{obs,1}, s_{obs,2} ... s_{obs,N}$

$$s_{obs,i} = \left(F s_{obs}^2\right)^{0.5}$$

Where *F* is the Fisher distribution

Mean:

Realizations of $\bar{x}_{obs} : \bar{x}_{obs,1}, \bar{x}_{obs,2} ... \bar{x}_{obs,N}$

$$\bar{x}_{obs,i} = \bar{x}_{obs} + T\left(\frac{s_{obs}^2 + s_{obs,i}^2}{n_{obs}}\right)^{0.5}$$

Where *T* is the Student’s distribution

Conclusion

- Gaining confidence in the prediction of concentrations of mine outflows or receiving environment
- Defining source loadings within realistic ranges from observed samples
- Expert judgment for the generation of concentrations that are conservative but not unrealistic given the existing knowledge of the source waters
- Characterization of uncertainties

Acknowledgment

To my colleagues:
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- Tasha Hall

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Questions?