

AN INTEGRATED APPROACH TO UNCERTAINTY ASSESSMENT IN LCA

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Overview

- Quantitative uncertainty analysis enhances LCA's decision-support capabilities but:
 - Danger of over-simplifying problem
 - Creating false sense of accuracy
- Needs to be an integral part of the decision-making process
- Considerable value as a structuring / learning tool
- Should not merely quantify uncertainty but provide mechanism to manage / reduce uncertainties

Sources of Uncertainty

Empirical Parameters <i>(Probabilistic assessment)</i>	Parameter uncertainty	Measurement errors Inherent randomness Subjective judgement Approximation
	Variability	Geographic variability Temporal variability Technological variability
Model Parameters <i>(Parametric sensitivity analysis / multivariate analysis)</i>	Uncertainty arising from choice of variables to specify system	Decision variables Model domain parameters
	Disagreement	Value parameters
Model structure / form <i>(Sensitivity analysis)</i>	Limitations on form of model	Choice of LCA method
	Limitations of LCA model structure.	Spatial limitations Temporal limitations Inherent model uncertainties

Reducing Empirical Uncertainty

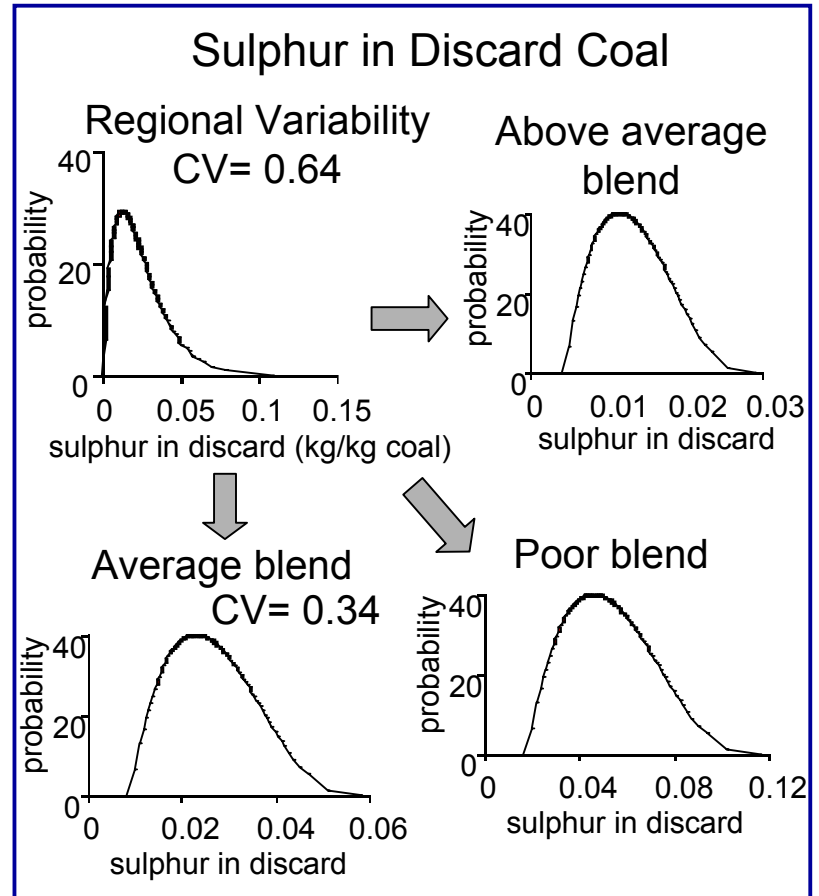
Empirical Parameter Uncertainty

- Arises from short-cuts in data collection and/or model simplifications
 - Increased data collection and/or modelling effort required
 - Hence need for *uncertainty importance analysis*
 - Can't always reduce, but useful to identify limiting parameters
- Measurement errors / inherent randomness
 - Take more measurements
- Pseudo-random quantities / approximations
 - Model underlying processes
- Subjective judgement
 - Refine measurement / measure more appropriate quantity

Managing Empirical Uncertainty

Variable Quantities

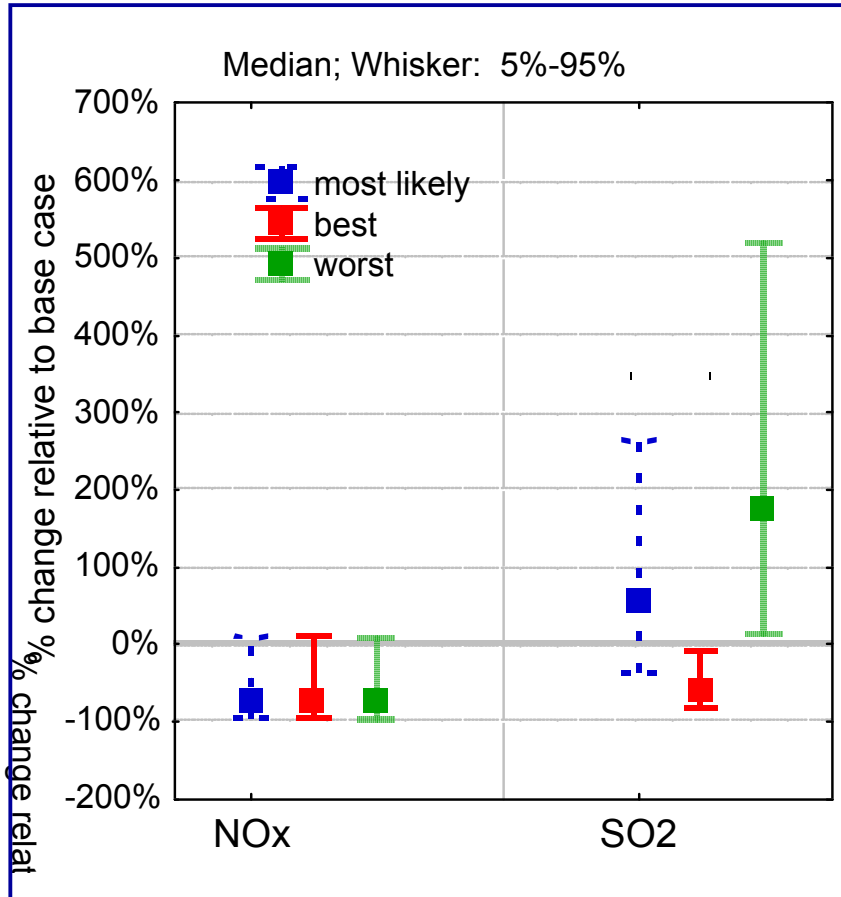
- Reduce variability by better definition of temporal, spatial, and technological placing of quantity
- Break down highly variable quantities into narrower bands of variability
 - Incorporate scenarios into model parameter uncertainty



Model Parameter Uncertainty

- Uncertainty managed rather than reduced
- Systematic parametric analysis ensures full solution space of system is explored
 - Present judicious choice of a few key scenarios covering full range of results
- Invaluable for structuring scenario generation in loosely defined problems
- Significance assessed with respect to empirical uncertainty

Model Parameter Uncertainty



- **No_x emissions:**
 - High degree of overlap
 - Indication model parameter uncertainty of less importance
- **SO₂ emissions:**
 - Widely spread scenarios
 - Effort best focussed on better definition of system than on reducing empirical uncertainty

Conclusions

- Quantitative uncertainty analysis placed in overall context of decision making process
- Shown to provide valuable assistance in:
 - Selection of meaningful criteria for comparison
 - Directing further data collection and modelling efforts
 - Generating scenarios to be taken further in analysis
- Argue for change of emphasis:
 - Unrealistic to expect objective, precise uncertainty estimates
 - Rather emphasise value in structuring and guiding the decision analysis process