Modelling life cycle impacts of toxics on humans and ecosystems with the USEtox^{TM} model

1-day course

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Programme

9.00 General introduction (M.Hauschild)
- Programme
- Source to damage cause-effect chain relationship and modelling steps

9.20 Chemical fate modelling (M.Birkved)
- Overview of typical environmental mass balance concepts
- Introduction to transport and degradation rate calculations as well matrix solutions.

10.40 Break

11.00 Human Exposure Modelling (R. Rosenbaum)
- Overview of human exposure concepts
- Direct and indirect pathways
- Subsistence vs. production-based approaches to food-based exposures.

12.30 Lunch

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Programme

13.30 Effects Modelling (S.I Olsen and H.F. Larsen)
- Risk-based and DALY-based human toxic effect factors
- EC50-based ecotoxicity effect factors
- Characterisation factors

15.00 Calculation of characterization factors (M. Hauschild)
- Fate, exposure and effect modelling into unique metric

15.20 Break

15.40 Source to impact framework and uncertainty (R.Rosenbaum)
- Matrix approach, USEtox^{TM} model

16.00 Overall Modelling with USEtox (All)
- Characterisation factors for human health impacts and ecotoxicological impacts

17.00 Course adjourned

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Teachers

Morten Birkved
Assistant professor, system modelling and life cycle inventory analysis, environmental models

Ralph Rosenbaum
Associate professor, chemical-related impacts in life cycle impact assessment, involved in development of USEtox

Stig I Olsen
Associate professor, human toxicology, decision support tools for management and development based on LCA

Henrik Fred Larsen
Senior research associate, ecotoxicology, use of LCA for optimisation of wastewater treatment systems

Michael Hauschild
Professor, life cycle impact assessment and sustainability assessment, involved in development of USEtox

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In summary…

LCA aims to cover all relevant environmental impacts represented by impact categories and indicators

In order to avoid unwanted bias, best estimate is aimed for in the characterisation modelling

LCIA assesses impacts at midpoint or endpoint in impact pathway

Characterisation factors are substance-specific expressions of relative hazardousness or impact potential

Indicator scores are aggregated over the life cycle

Characterisation of chemical impacts inspired by ERA but fundamental differences exist

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Characterisation
- how much does the emission contribute?

Quantitatively determine the impact score per environmental category

$$IS = \sum_i \sum_x CF_{x,i} \cdot m_{x,i}$$

IS = impact score
CF = characterisation factor
m = life cycle emission
x = substance type
i = compartment type

a Characterisation Factor is a quantitative representation of the (relative) hazardousness of a specific emission
expressed in absolute metric or relative to a reference substance
e.g. the human toxicity characterisation factor of benzene is 300 CTU

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Environmental impacts at endpoint

- Damage to human health *(e.g. Years of Life Lost)*
- Damage to ecosystem quality *(e.g. Disappeared fraction of species)*
- Damage to resources *(e.g. Extra energy demand)*
- Damage to the man-made environment *(e.g. Euros)*

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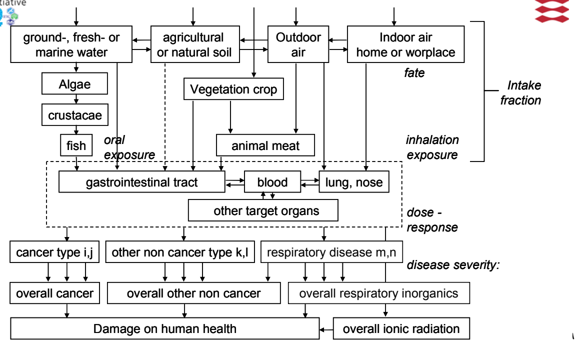
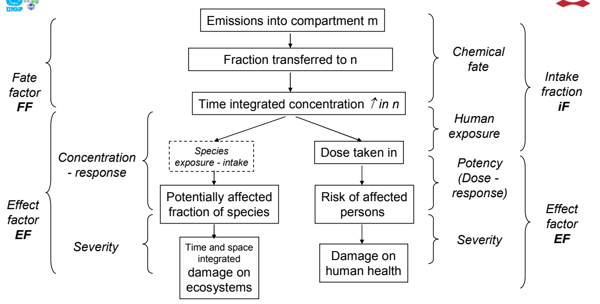
Impact pathway for Human toxicity



Characterisation of eco and human toxicity



Ecotoxicity: CF=FF·EF Human toxicity: CF=iF·EF

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Calculation of characterisation factors

9.20 Chemical fate modelling (M.Birkved)	**FF**	**iF**
11.00 Human Exposure Modelling (R. Rosenbaum)	**XF**	
13.30 Effects Modelling (S.I Olsen and H.F. Larsen)	**EF**	
15.00 Calculation of characterization factors (M. Hauschild)	**CF**	
15.40 Source to impact framework (R.Rosenbaum)	**CF = iF·EF**	
16.00 Overall Modelling with USEtox (All)	**CF = FF·EF**	

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