

Modelling human and ecosystems exposure and impacts for life-cycle assessment: the USEtox® consensus model

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Abstract

To address the increasing needs for methods to assess impacts of toxic chemical emissions on human health and ecosystems, this course provides a practical overview of multimedia chemical fate modelling, multi-pathway human exposure modelling, ecosystem and human health effects modelling, and comparative indicators for human toxicological and ecotoxicological impacts. We begin by explaining basic concepts of environmental mass balance modelling - including partitioning coefficients, first order rate coefficients, cross-medial transport, and persistence. We next present the fundamentals of multi-pathway models for human intake via inhalation, drinking water and food. We will review hazard-based and risk-based effects modelling approaches that are used to assess effect factors and illustrate how fate, exposure, effect and damage factors can be combined to construct factors to characterize chemical emissions. We then guide the participants through a series of examples in which they will develop characterization factors for human-toxicological and ecotoxicological impacts using the USEtox® consensus model. Students will explore USEtox® as a tool for comparative assessment of chemical fate, exposure and effects. We will conclude with a demonstration of how the model can be used in various applications, including the prioritization and ranking of chemicals for institutions like the European Commission or the U.S. Environmental Protection Agency.

Course objectives

The aim of this course is to introduce participants to the exposure science methods used in life-cycle and comparative risk assessments. Participants will learn to use and evaluate basic tools for mass-balance, fate modelling, intake fraction, and effect factor estimation. Participants will review underlying model assumptions and evaluate data needs along with data and knowledge gaps in these assessments.

The course is intended for environmental science practitioners interested in the scientific fundamentals of chemical impact assessment for a broad range of environmental emissions. Only basic background knowledge of environmental modelling, risk assessment or life cycle assessment is considered necessary.

Participants will come away with knowledge of basic concepts of exposure science for chemical impact assessment and be able to perform their own assessment using the USEtox® consensus model and interpret results.

Course level

Intermediate